USER'S GUIDE

T-BERD 209A/211

T-CARRIER ANALYZER

Telecommunications
Techniques
Corporation

A DYNATECH COMPANY

EXPECT EXCELLENCE

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Rev. N

T-BERD 209A/211
T-CARRIER ANALYZER

USER'S GUIDE

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INTRODUCTION

The *T-BERD 209A/211 User's Guide* offers an easy, direct method to set up and operate the T-BERD 209A/211 within your network. The user's guide presents the most often used test setups in complete and concise steps. Illustrations, helpful notes, and step-by-step procedures make this user's guide a unique aid for novice and experienced users alike.

If you are unfamiliar with the instrument, please refer to the *T-BERD 209A/211 Reference Manual* for more detailed information. If you should require additional help, call TTC Customer Service at (800) 638-2049.

The user's guide is divided into the following four sections:

BASIC SETUPS — Describes setup procedures to generate printouts, perform timed tests, and set up the T-BERD 209A/211 with the T-BERD Repeater Extender for mid-span tests.

APPLICATIONS — Describes setup procedures and results interpretation for several T-BERD 209A/211 applications. Each application identifies the test scenario, the purpose of the test, and the required options. The tests are grouped as follows:

- Testing T1 Networks
- Testing Cable Pairs
- Testing Newly Installed T1 Spans
- Testing Digital Loop Carrier (DLC) Networks

AUXILIARY FUNCTIONS — Lists the T-BERD 209A/211 and T-BERD DLC Analyzer Option auxiliary functions.

SIGNAL ALARMS AND TEST RESULTS — Lists the T-BERD 209A/211 and T-BERD DLC Analyzer Option signal alarm definitions and test results by category.

This user's guide contains applications for the following T-BERD 209A/211 options. The options used are identified at the beginning of the application. One or more of the options may be used in a single application.

Option 209A/211-1	G.821 Performance Analysis Option
Option 211-2	Jitter Spectral Analysis Option
Option 209A/211-3	Advanced BERT Option
Option 209A/211-4	Enhanced ESF Option
Option 209A/211-5	Time Domain Reflectometer Option
Option 209A/211-6	Fractional T1 Option
Option 209A/211-96	T-BERD DLC Analyzer Option
Model 40849	T-BERD T1 Channel Monitor Option
Model 41084	T-BERD Repeater Power Supply Option

1. GENERATING PRINTOUTS
TTC PR-40A THERMAL PRINTER OR EQUIVALENT REQUIRED

The following information may be used to configure the T-BERD 209A/211 and a compatible printer, such as the TTC PR-40A Thermal Printer, to generate results and controls printouts. The printer connection is found on the side panel.

If a printer is not available, you can still generate printouts by storing them in the internal print buffer.

1. **MODE switch**
   Select the AUX mode.

2. **PATTERN switch**
   Set the following auxiliary functions:

Auxiliary Function	Selections	Comments
AUX BAUD	300, 1200, 2400, or 4800	Sets the RS-232 interface baud rate. Recommend 2400 baud for PR-40A.
AUX PARITY	NONE, ODD, or EVEN	Sets the RS-232 interface parity. Set parity to NONE when printing pulse shape, TDR, and jitter spectral analysis graphs. Recommend NONE for PR-40A.
AUX PRNT FMT	SHORT FORMAT, NORMAL FORMAT, SUMMARY PRINT	Determines what results format is printed. Recommend NORMAL FORMAT.
AUX TERM	CR or CRLF	Sets printout line terminator. Set the terminator to CR when printing pulse shape, TDR, and jitter spectral analysis graphs. Recommend CR for PR-40A.

3. **MODE switch**
   Exit the auxiliary functions.

4. **Connect a printer to the T-BERD 209A/211**
   Connect an RS-232 serial cable between the printer and T-BERD 209A/211.

5. **PRINT switch**
   Press the CONTROLS side of the switch to generate a controls printout to verify the proper operation of the printer and T-BERD 209A/211.

6. **PRINT EVENT switch**
   Select the necessary print event function to generate the appropriate results printout. Printouts for pulse shape, TDR, and jitter spectral analysis graphs are described in the appropriate application.

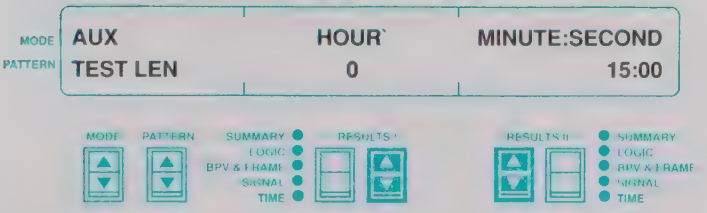
2. CONFIGURING FOR A TIMED TEST

The following procedure enables the user to run an unattended test for an extended period and collect test results during and after the test. Perform the following procedure to set up the T-BERD 209A/211 for a timed test and print the results at the end of the test. Specific results printouts are generated during the test by selecting the desired print event function with the **PRINT EVENT** switch.

1. **Connect compatible printer (optional)**
   Refer to *Application 1, Generating Printouts*, to connect a printer.

2. **MODE switch**
   Select the AUX mode.

3. **PATTERN switch**
   Select AUX TEST LEN to set the desired duration.



4. **MODE switch**
   Exit the auxiliary functions.

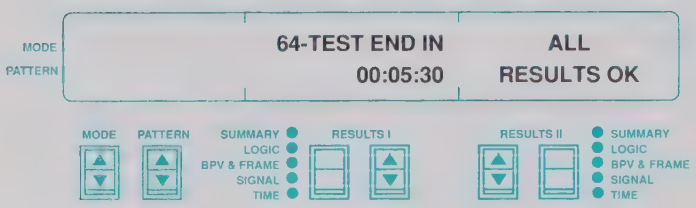
5. **PRINT EVENT switch (optional)**
   Select TEST END to generate the test end results printout at the end of the test when the **TEST** switch is set to TIMED. A test end results printout can also be printed from other print events simply by setting the **TEST** switch to TIMED.

6. **TEST switch**

   Select TIMED test. Selecting the TIMED test restarts the test.

7. **RESULTS switches**

   Select the TIME category 64-TEST END IN result in the RESULTS I window and the SUMMARY category in the RESULTS II window.



When the 64-TEST END IN result equals 00:00:00, the test is complete. *TIMED TEST COMPLETE* flashes alternately with the test result in the RESULTS I window, and the test result counts are frozen.

3. CONNECTING AT MID-SPAN
T-BERD T1 REPEATER EXTENDER REQUIRED

The following procedure enables the user to connect the T-BERD 209A/211 to a T1 circuit at a span repeater location. Refer to the *T-BERD T1 Repeater Extender Model 41157 Operating Manual* for more detailed configurations. Figure 1 illustrates how the T-BERD 209A/211 and the T-BERD Repeater Extender are connected to the T1 span.

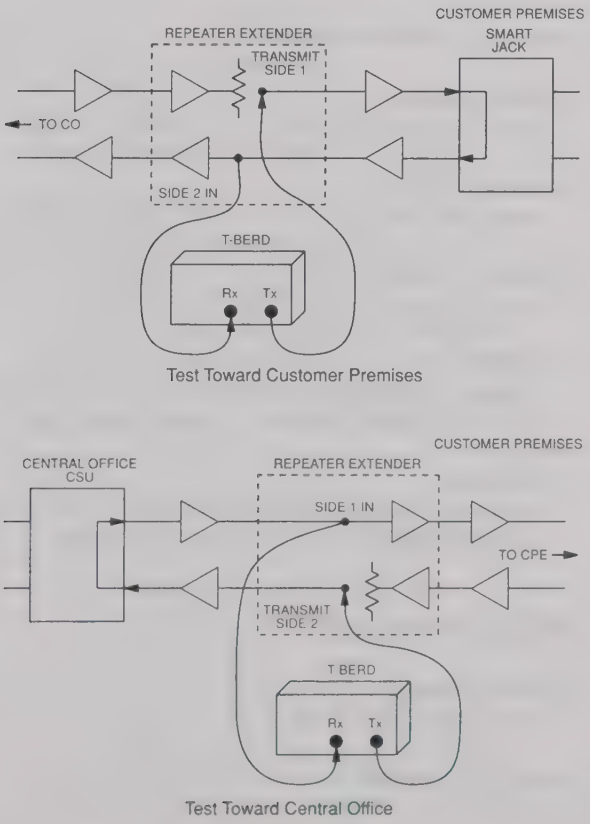


Figure 1
Testing from Mid-Span

T-BERD Repeater Extender Test Setup

1. **Remove repeater**
   Remove the desired repeater from the repeater housing unit and insert the repeater into the T-BERD Repeater Extender.

2. **Insert T-BERD Repeater Extender**
   Insert the T-BERD Repeater Extender into the desired repeater slot.

Test Toward Customer Premises

1. **TRANSMIT switch**
   Set this switch to TX SIDE 1.

2. **SIGNAL PATH switch**
   Set this switch to THRU.

3. **CURRENT PATH switch**
   Set this switch to THRU.

4. **TRANSMIT jack**
   Connect a cable between the T-BERD 209A/211 TRANSMIT jack and the T-BERD Repeater Extender TRANSMIT jack.

5. **SIDE 2 IN jack**
   Connect a cable between the T-BERD 209A/211 RECEIVE jack and the T-BERD Repeater Extender SIDE 2 IN jack.

Test Toward Central Office

1. **TRANSMIT switch**
   Set this switch to TX SIDE 2.

2. **SIGNAL PATH switch**
   Set this switch to THRU.

3. **CURRENT PATH switch**
   Set this switch to THRU.

4. **TRANSMIT jack**
   Connect a cable between the T-BERD 209A/211 TRANSMIT jack and the T-BERD Repeater Extender TRANSMIT jack.

5. **SIDE 1 IN jack**
   Connect a cable between the T-BERD 209A/211 RECEIVE jack and the T-BERD Repeater Extender SIDE 1 IN jack.

T-BERD 209A/211 Test Setup

1. **RECEIVE INPUT switch**
   Select the BRIDGE input level.

2. **TRANSMIT OUTPUT switch**
   Select the 0dB(DSX) output level.

3. **Configure T-BERD 209A/211**
   Configure the T-BERD 209A/211 as described in one of the following loopback applications.

APPLICATIONS

This section provides information on operating the T-BERD 209A/211 in a variety of common test applications. Each application describes how to configure the T-BERD 209A/211 mainframe, connect to the circuit being tested, and interpret the test results. If an option is required, the mainframe and option setup procedures are subdivided, and the option is indicated in the title of the application. The test scenarios and instrument setups are grouped into the following applications:

Testing T1 Networks

Testing Cable Pairs

Testing Newly Installed T1 Spans

Testing Digital Loop Carrier (DLC) Networks

TESTING T1 NETWORKS

MONITORING T1 PERFORMANCE

MEASURING T1 TIMING SLIPS AND WANDER

MEASURING T1 PULSE SHAPES

MEASURING T1 JITTER

PERFORMING T1 JITTER SPECTRAL ANALYSIS

PERFORMING A T1 LOOPBACK

EMULATING A CSU AT CUSTOMER PREMISES

TESTING WITH MULTIPAT AND BRIDGTAP PATTERNS

MONITORING DS0 CHANNELS

MONITORING FT1 PERFORMANCE

MONITORING ESF PRMS

RETRIEVING ESF CIRCUIT PERFORMANCE DATA

TESTING INTELLIGENT REPEATER SPANS

4. MONITORING T1 PERFORMANCE

- Non-intrusively monitor the T1 facility.
- Monitor the T1 signal for BPVs and frame errors (CRC errors if ESF framing).
- Measure the T1 signal level and frequency.

Figure 2 illustrates the T-BERD 209A/211 monitoring the T1 signal from the DSX-1 access point.

1. **MODE switch**
   Select AUTO mode.

2. **TEST switch**
   Set to CONT.

3. **TIMING switch**
   Set to RECOVD (LOOP).

4. **RECEIVE INPUT switch and jack**
   Select the DSX-MON input level and connect a cable between this jack and the span-side DSX-1 MON jack.

5. **RESTART switch**
   Clear the results and start the test.

6. **MODE/PATTERN window**
   Verify received framing format and pattern. The framing format and pattern (or *live*) appear in lowercase characters.

7. **Status LEDs**
   These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern Sync (if applicable), and B8ZS (if applicable).

8. **RESULTS I switches**
   Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.

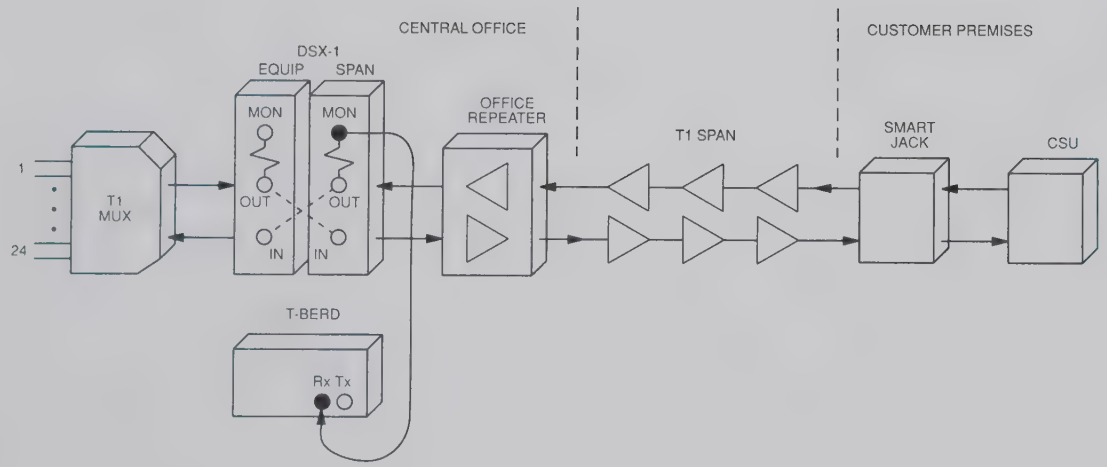
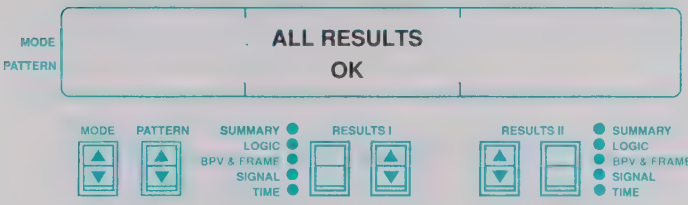


Figure 2
Monitoring T1 Performance



9. **Results interpretation**

25-VIOLATIONS, 30-FRM ERRORS, and 32-CRC ERRORS (ESF framing only)

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or a faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument.

40-RX FREQ, Hz

The DS1 received frequency should be 1.544 MHz ±75 Hz. If the frequency is out-of-specification, check the transmission equipment timing or network synchronization.

41-RX LEVEL (dBdsx)

The received level should be -20 dBdsx ±1.5 dBdsx at resistor isolated DSX-1 MON jacks. Incorrect levels could be caused by a faulty T1 line card or poor cabling between the DSX jack and the equipment.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate that it is not receiving a T1 signal.

All Ones LED

An Alarm Indication Signal (AIS) indicates that equipment in the signal path is not receiving the T1 signal from the far end.

5. MEASURING T1 TIMING SLIPS AND WANDER

- Confirm that all the network equipment is properly synchronized.
- Verify network timing and wander.
- Isolate possible timing problems and wander.

Figure 3 illustrates the T-BERD 209A/211 testing for the presence of timing slips when the received T1 signal is compared with a reference T1 clock source at the DSX-1 access point.

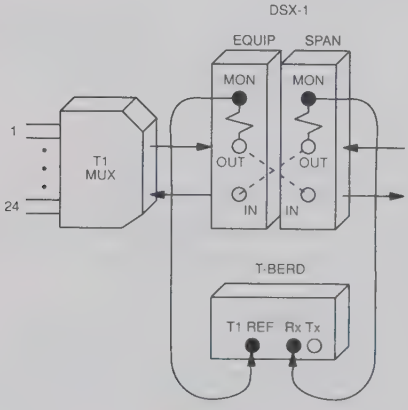


Figure 3
Measuring T1 Timing Slips

1. **MODE switch**
   Select AUTO mode.

2. **TEST switch**
   Set to CONT.

3. **TIMING switch**
   Set to RECOVD (LOOP).

4. **RECEIVE INPUT switch and jack**
   Select the DSX-MON input level and connect a cable between this jack and the span-side DSX-1 MON jack.

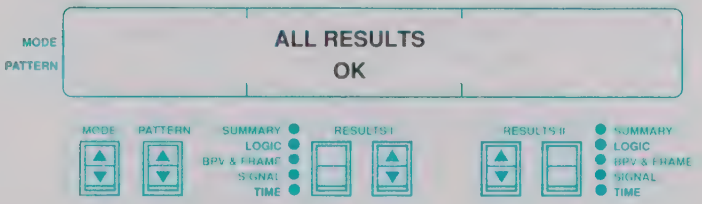
5. **T1 REF (TDR) jack**
   Connect a cable between this jack and the equipment-side DSX-1 MON jack.

6. **RESTART switch**
   Clear the results and start the test.

7. **MODE/PATTERN window**
   Verify received framing format and pattern. The framing format and pattern (or *live*) appear in lowercase characters.

8. **Status LEDs**
   These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern Sync (if applicable), and B8ZS (if applicable).

9. **RESULTS I switches**
   Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



10. **RESULTS switches**
    Select the SIGNAL category 53-SLP ANA SEC and 51-TIMING SLIP results.

11. Results interpretation

51-TIMING SLIP

The 51-TIMING SLIP result is only available when the timing reference source is connected to either the T1 REF (TDR) jack or the EXT CLK IN connector. Figure 4 shows the bar graph and wheel values that determine the direction and number of timing slips being detected.

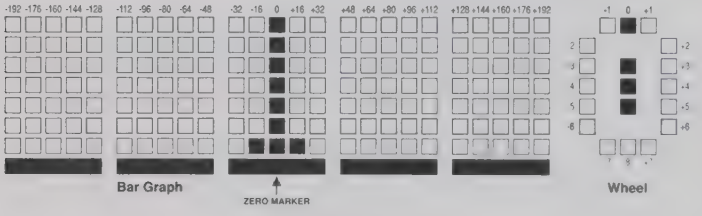


Figure 4
Timing Slip Bar Graph and Wheel Values

If the T1 reference and receive signals are perfectly synchronized, the timing slip count remains at 0, the bar graph remains centered, and the wheel remains at top center.

If the T1 reference and received signals are synchronized, but one signal exhibits low-speed wander (e.g., Doppler shifts from satellites), the timing slip count remains at 0, the wheel moves clockwise, and the bar graph moves to the right as the satellite nears. As the satellite moves farther away, the timing slip count remains at 0, the wheel moves counterclockwise, and the bar graph moves to the left.

If the T1 reference and received signals are not synchronized, and the received signal frequency is higher than the T1 reference signal, the wheel moves clockwise, the bar graph moves to the right, and the timing slip count increments every 193 bit slips. The timing slip count, bar graph, and wheel move very rapidly when the frequency differs more than a few Hertz.

If the T1 reference and received signals are not synchronized, and the received signal frequency is lower than the T1 reference signal, the wheel moves counterclockwise, the bar graph moves to the left, and the timing slip count increments every 193 bit slips. The timing slip count, bar graph, and wheel move very rapidly when the frequency differs more than a few Hertz.

53-SLP ANA SEC

The 53-SLP ANA SEC result increments when both the T1 reference signal and the received T1 signal are present and timing slips are occurring.

70-WANDER +PK, 71-WANDER -PK, and 72-P-P WANDER

Positive-peak, negative-peak, and peak-to-peak wander results indicate maximum wander conditions since the beginning of the test. Wander can be monitored to determine whether it exceeds tolerances for the terminal buffers. Wander is measured in Unit Intervals (UIs); 1 UI is equivalent to a single T1 timeslot or one bit space in a buffer. Wander is a form of jitter that occurs at frequencies of less than 10 Hz.

73-15m WANDER and 74-24h WANDER

The 15-minute and 24-hour wander results indicate the maximum peak-to-peak wander over the last indicated period. The 15 minute result is not available for the first 15 minutes of the test and is updated once per minute. The 24-hour result is not available for the first 24 hours of the test and is updated once per hour.

75-TIE WANDER

The Time Interval Error wander result is a measurement of the instantaneous displacement of the received T1 signal from the reference signal since the beginning of the test. This result can be positive or negative.

6. MEASURING T1 PULSE SHAPES

- Measure waveform against standard pulse shape masks (ANSI T1.403, AT&T CB119).

Figure 5 illustrates the T-BERD 209A/211 connected to the span through the DSX-1 patch panel to loop the far-end equipment and test the signal pulse shape.

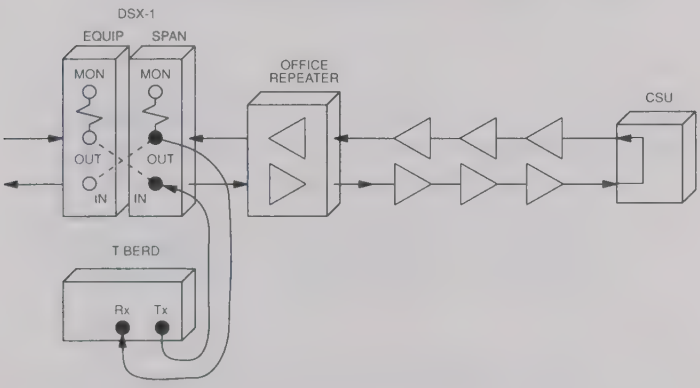
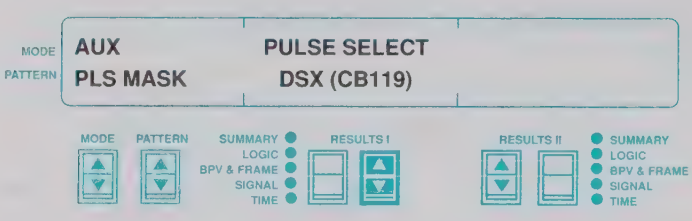


Figure 5
Measuring the DS1 Pulse Shapes

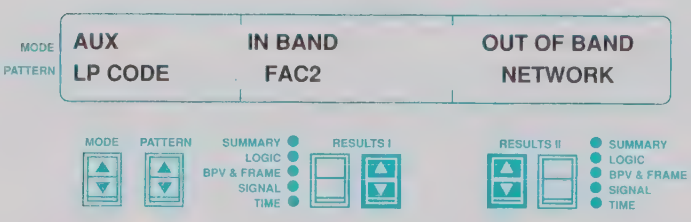
1. **Connect compatible printer (optional)**
   Refer to *Application 1, Generating Printouts*, to connect a printer to the T-BERD 209A/211.

2. **MODE switch**
   Select the AUX mode.

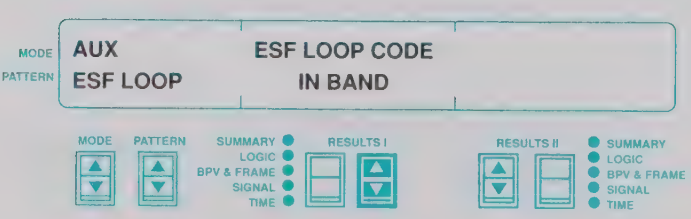
3. **PATTERN switch**
   Select AUX PLS MASK to set the pulse mask. Select NI (ANSI) when testing from the network interface, and DSX (CB119) when testing from the DSX-1 access point.



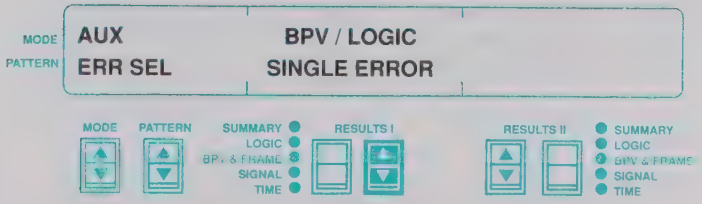
Select AUX LP CODE to set the appropriate loop code.



If testing T1 ESF circuits, select AUX ESF LOOP to set the loop code type.



Select AUX ERR SEL to set the burst duration to insert a single error.



4. **MODE switch**
   Exit the auxiliary function and select the appropriate T1 network framing format.

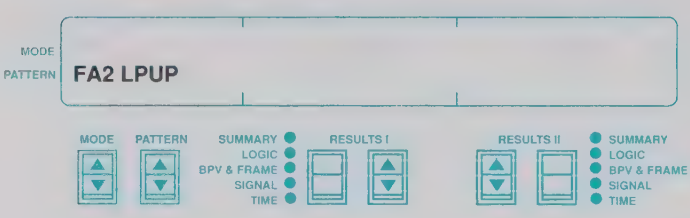
5. **PATTERN switch**
   Select the 1:7 test pattern.

6. **TIMING switch**
   Set to INT.

7. **RECEIVE INPUT switch and jack**
   Select the TERM input level and connect a cable between this jack and the span-side DSX-1 OUT jack.

8. **TRANSMIT OUTPUT switch and jack**
   Select the 0dB(DSX) output level and connect a cable between this jack and the span-side DSX-1 IN jack.

9. **LOOP UP switch**
   Press this switch to send the loop-up code. The switch and Loop Up LED illuminate until the loop code is detected. A loop-up code message appears in the display. The test restarts when the loopback is established.



10. Status LEDs

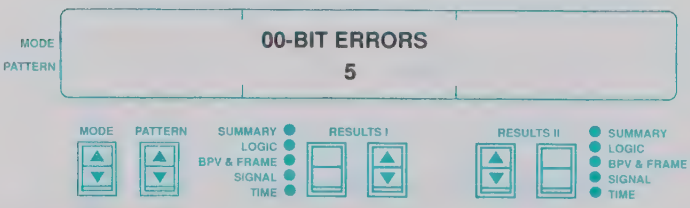
When the loopback is established, these LEDs should illuminate: T1 Pulses, Pattern Sync, Frame Sync, and B8ZS (if applicable).

11. RESULTS I Category switch

Select the SUMMARY category.

12. LOGIC ERROR INSERT switch

Press this switch five times to verify that the logic errors are received and the T1 circuit is looped back.



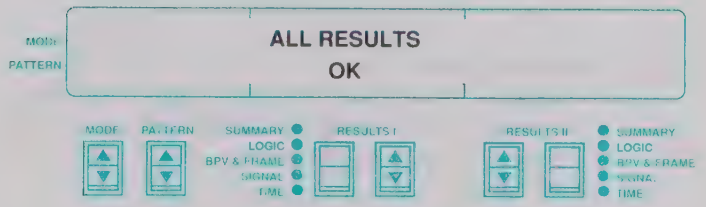
If the loopback is not established, the bit errors do not appear in the display. The failed loopback could be the NIU/CSU not operating correctly, the line from you to the NIU/CSU is bad, or the transmitted loop code is incorrect.

13. RESTART switch

Clear the results and start the test.

14. RESULTS I switches

Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



15. Results interpretation

41-RX LEVEL (dBdsx)

The received level should be +4 to -4 dBdsx at terminated DSX-1 OUT jacks to measure the pulse shape. Levels outside this range cause the message *OUT OF RANGE* to appear in the pulse shape results.

44-PULSE SHAPE

This indicates a pass/fail response to whether the measured pulse shape falls within the selected pulse mask.

45-PULSE WIDTH

This indicates the pulse width at the 50% point of the waveform. The DSX (CB119) specification requires a pulse width of 350 ns ±56 ns. The NI (ANSI) specification requires a pulse width of 356 ns ±56 ns.

46-RISE TIME

This indicates the rise time of the leading edge between the 10% and 90% points of the waveform. The DSX (CB119) specification requires a rise time of less than 140 ns. The NI (ANSI) specification requires a rise time of less than 152 ns.

47-FALL TIME

This indicates the fall time of the trailing edge between the 10% and 90% points of the waveform. The DSX (CB119) specification requires a fall time of less than 117 ns. The NI (ANSI) specification requires a fall time of less than 125 ns.

48-UNDERSHOOT

The undershoot is the amount of the trailing edge that falls below the zero point of the waveform. The DSX (CB119) and NI (ANSI) specifications require an undershoot of less than 45% of the normalized pulse.

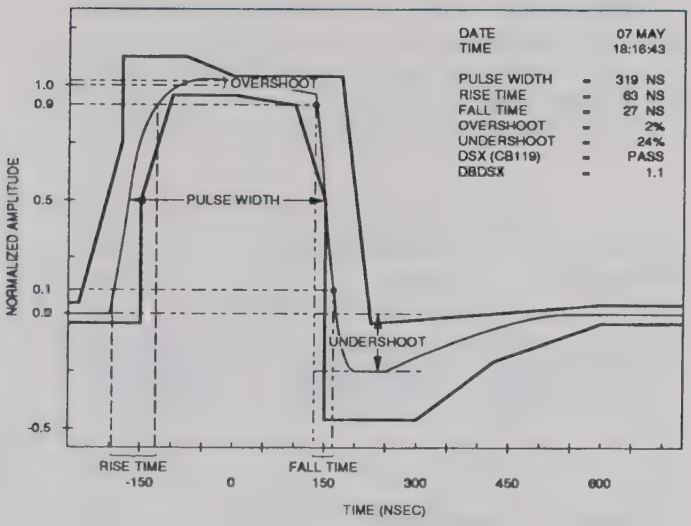
49-OVERSHOOT

The overshoot is the amount of the leading edge that rises above the 100% point of the waveform. The DSX (CB119) specification requires an overshoot of less than 15% of the normalized pulse. The NI (ANSI) specification requires an overshoot of less than 20% of the normalized pulse.

Pulse Shape LED

When either pulse mask is selected, the LED illuminates when the pulse shape exceeds the pulse mask specifications. When NONE is selected, the Pulse Shape LED is disabled, the message *NO MASK* appears in the 44-PULSE SHAPE result, and no mask appears on the pulse shape printout.

A pulse mask is a graphical representation of the guidelines or template that is placed on the pulse shape. Figure 6 depicts a sample pulse mask, pulse waveform, and the expected pulse shape parameters by the indicated pulse mask. The pulse width, rise time, fall time, undershoot, and overshoot are indicated in Figure 6 as well as results in the SIGNAL category.



EXPECTED PULSE SHAPE PARAMETERS

PARAMETER	MASK	
	DSX	NETWORK INTERFACE
Pulse Width	350 ± 56 ns	356 ± 56 ns
Rise Time	< 140 ns	< 152 ns
Fall Time	< 117 ns	< 125 ns
% Overshoot	< 15%	< 20%
%Undershoot	< 45%	< 45%

Figure 6
T1 Pulse Shape and Pulse Mask Specifications

Print Pulse Shape Graphs

16. **MODE switch**
    Select the AUX mode.

17. **PATTERN switch**
    Select the AUX GRAPH function.

18. **RESULTS I Results switch**
    Press this switch to generate a pulse shape graph (see Figure 7).

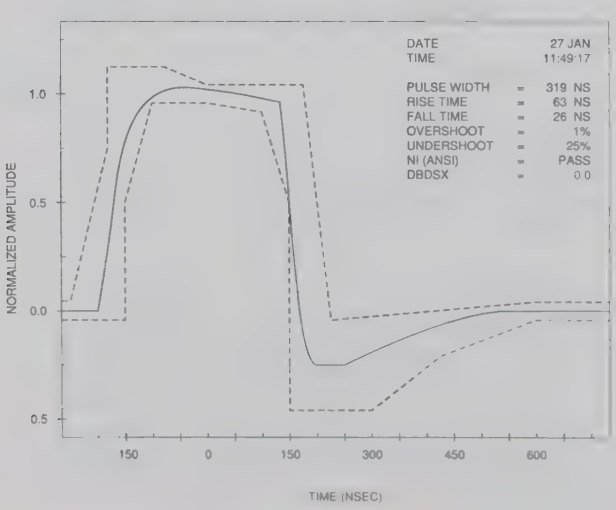
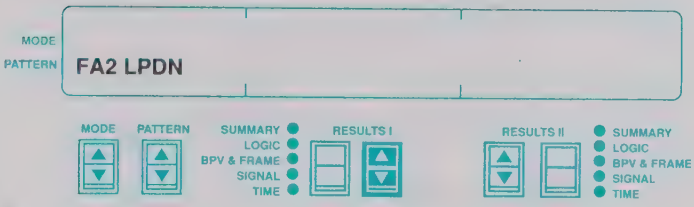


Figure 7
T1 Pulse Shape Graph

Disconnect the T-BERD 209A/211

19. LOOP DOWN switch

Press this switch to send the loop-down code. The switch and Loop Down LED illuminate until the loopback is released. A loop-down code message appears in the display. Disconnect the T-BERD 209A/211 from the span.



7. MEASURING T1 JITTER
T-BERD 211 ONLY

- Non-intrusively monitor the T1 facility for jitter.
- Measure the T1 signal for the current and maximum peak-to-peak wideband and highband jitter.

Figure 8 illustrates the T-BERD 211 monitoring the T1 signal for jitter from the DSX-1 access point.

1. **MODE switch**
   Select AUTO mode.

2. **TIMING switch**
   Set to RECOVD (LOOP).

3. **RECEIVE INPUT switch and jack**
   Select the DSX-MON input level and connect a cable between this jack and the span-side DSX-1 MON jack.

4. **RESTART switch**
   Clear the results and start the test.

5. **MODE/PATTERN window**
   Verify received framing format and pattern. The framing format and pattern (or live) appear in lowercase characters.

6. **Status LEDs**
   These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern Sync (if applicable), and B8ZS (if applicable).

7. **RESULTS I switches**
   Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.

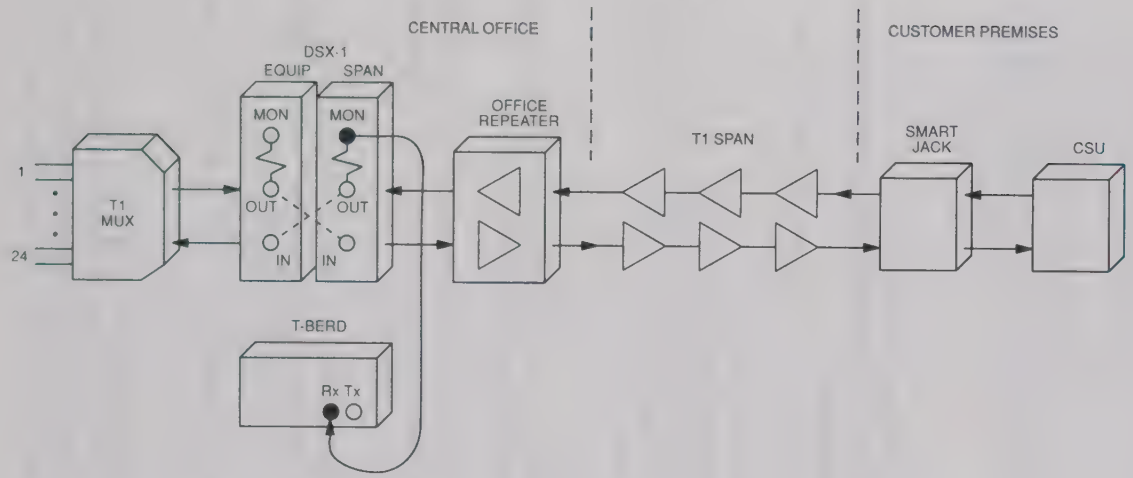
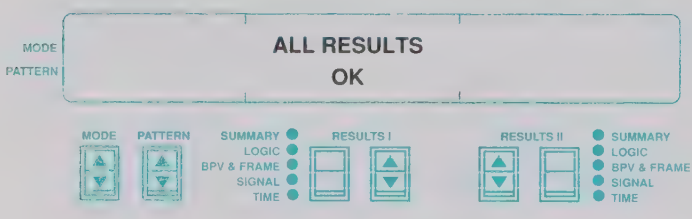


Figure 8
Measuring T1 Jitter



8. **Results interpretation**

25-VIOLATIONS, 30-FRM ERRORS, and 32-CRC ERRORS (ESF framing only)

Excessive jitter causes BPVs, frame errors, and CRC errors.

41-RX LEVEL (dBdsx)

The received level should be -16 dBdsx to -24 dBdsx at resistor isolated DSX-1 MON jacks to measure the T1 jitter. Levels outside this range cause the message *OUT OF RANGE* to appear in the jitter results.

80-WB/HB JIT

Check this result to determine if the wideband and highband jitter and the signal level are within specifications.

PASS appears when the wideband jitter is less than 5.0 UI and highband jitter is less than 0.1 UI. The signal level is within prescribed limits.

FAILED appears when the wideband jitter is greater than 5.0 UI and highband jitter is greater than 0.1 UI. The signal level is within prescribed limits.

OUT OF RANGE appears when the signal level is outside prescribed limits.

81-WB JITTER and 82-HB JITTER

If the 81-WB JITTER result exceeds 5.0 UI, then a multiplexer may be causing the excess wideband jitter. Multiplexers often cause waiting time jitter, which appears as low frequency jitter.

If the 82-HB JITTER exceeds 0.1 UI, and the 81-WB JITTER result reads the same value, then a span line problem such as a bad repeater may be causing the jitter.

84-MAX WB JIT and 85-MAX HB JIT

If the history Jitter LED illuminates, but the current Jitter LED is off, the maximum peak-to-peak wideband and highband jitter can be read from these results.

Jitter LED

This LED illuminates when wideband jitter exceeds 5.0 UI or highband jitter exceeds 0.1 UI.

8. PERFORMING T1 JITTER SPECTRAL ANALYSIS
JITTER SPECTRAL ANALYSIS OPTION REQUIRED, T-BERD 211 ONLY

- Measure the spectral jitter response against a selected jitter mask specification.

Figure 9 illustrates the T-BERD 211 connected to the span through the DSX-1 patch panel to loop the far-end equipment and test the full T1 bandwidth for jitter.

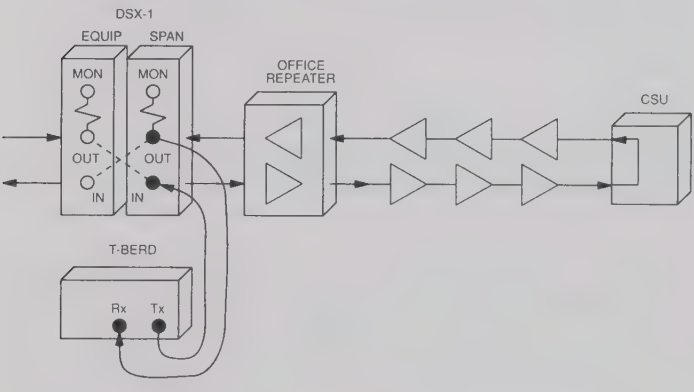


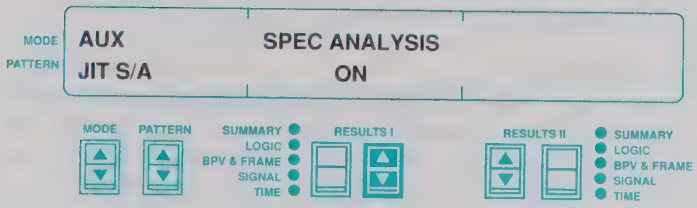
Figure 9
T1 Jitter Spectral Analysis During Loopback Testing

1. **Connect compatible printer (optional)**
   Refer to *Application 1, Generating Printouts*, to connect a printer to the T-BERD 211.

2. **MODE switch**
   Select the AUX mode.

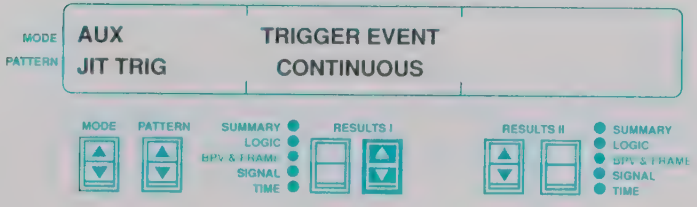
3. PATTERN switch

Select AUX JIT S/A to enable the Jitter Spectral Analysis Option.



Select AUX JIT MASK to set the appropriate jitter mask.

Select AUX JIT TRIG to set the appropriate jitter trigger.



4. **MODE switch**
   Select AUTO mode.

5. **TIMING switch**
   Set to RECOVD (LOOP).

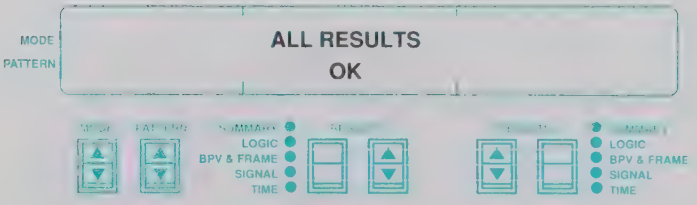
6. **Connections**
   Set the **RECEIVE INPUT** switch to TERM and **TRANSMIT OUTPUT** switch to 0dB(DSX). Connect a cable from the RECEIVE jack to the DSX-1 OUT jack and connect a cable from the TRANSMIT jack to the DSX-1 IN jack.

7. **RESTART switch**
   Clear the results and start the test.

8. **MODE/PATTERN window**
   Verify received framing format and pattern. The framing format and pattern (or live) appear in lowercase characters.

9. **Status LEDs**
   These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern Sync (if applicable), and B8ZS (if applicable).

10. **RESULTS I switches**
    Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



11. Results interpretation

41-RX LEVEL (dBdsx)

The received level should be +4 to -4 dBdsx at the terminated DSX-1 OUT jacks to measure the jitter. Levels outside this range cause the message *OUT OF RANGE* to appear in the jitter results.

88-SA P/F

Check this result to determine if the spectral content of each frequency band is within the selected jitter mask specification. Refer to Table 1 to determine which test results appear when configuring the jitter auxiliary functions.

PASS appears when the wideband jitter is less than 5.0 UI and highband jitter is less than 0.1 UI. The signal level is within prescribed limits.

FAILED appears when the wideband jitter is greater than 5.0 UI and highband jitter is greater than 0.1 UI. The signal level is within prescribed limits.

OUT OF RANGE appears when the signal level is outside prescribed limits.

89-SA FREQ (auto scrolling) and 90-SA FREQ (manual scrolling)

If any frequency band exceeds the jitter mask when the error event occurs, then jitter is the likely cause of the errors. This conclusion can be confirmed by taking several spectral analysis samples when no errors are present, and comparing them with the error event samples.

If the Jitter LED illuminates, but none of the frequency bands indicate jitter above 100% of the selected jitter mask, with no error events, then the errors may be caused by an in-phase summing of many jitter frequencies. Again, spectral analysis samples where errors are present should be taken to correlate the high jitter and low jitter measurements.

Table 1
Spectral Analysis Results and Auxiliary Functions

Results	Displayed Information	Auxiliary Function	Selection
88-SA P/F	N/A	AUX JIT S/A	OFF
89-SA FREQ	UNAVAILABLE	AUX JIT MASK	NONE
90-SA FREQ	(not shown)		
88-SA P/F	N/A	AUX JIT S/A	ON
89-SA FREQ	Frequencies and UI	AUX JIT MASK	NONE
90-SA FREQ	Frequencies and UI		
88-SA P/F	Pass/Fail/Unavailable	AUX JIT S/A	ON
89-SA FREQ	Frequencies and % Mask	AUX JIT MASK	Mask
90-SA FREQ	Frequencies and % Mask		
88-SA P/F	UNAVAILABLE	AUX JIT S/A	OFF
89-SA FREQ	UNAVAILABLE	AUX JIT MASK	Mask
90-SA FREQ	(not shown)		

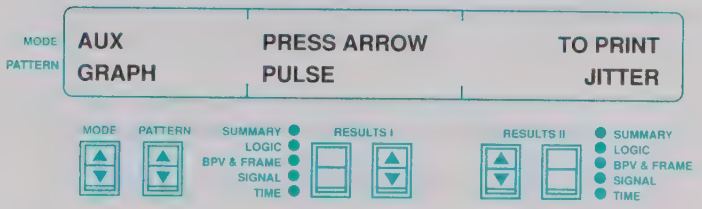
Jitter LED

When the Jitter Spectral Analysis Option is enabled and a jitter mask is selected, the LED illuminates when the jitter spectral response exceeds 100% of the selected jitter mask. When the Jitter Spectral Analysis Option is enabled but a jitter mask is not selected, the LED is disabled.

Printing Jitter Spectral Analysis Graph

12. **MODE switch**
    Select the AUX mode.

13. **PATTERN switch**
    Select the AUX GRAPH function.



14. RESULTS II Results switch

Press this switch to generate a jitter versus frequency graph (see Figure 10).

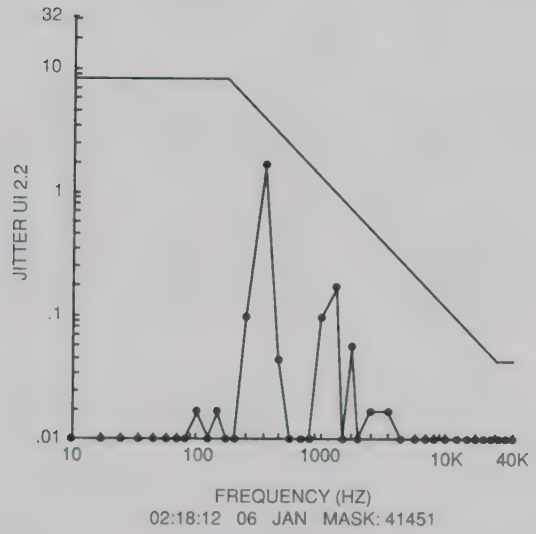


Figure 10
T1 Jitter vs. Frequency Graph

9. PERFORMING A T1 LOOPBACK

- Qualify T1 circuit error performance by testing for logic errors, BPVs, frame errors, and CRC errors (if applicable) on T1 lines.
- Check loopback response of transmission equipment.

Figure 11 illustrates the T-BERD 209A/211 connected to the span through the DSX-1 patch panel to loop the far-end equipment and test the full T1 bandwidth.

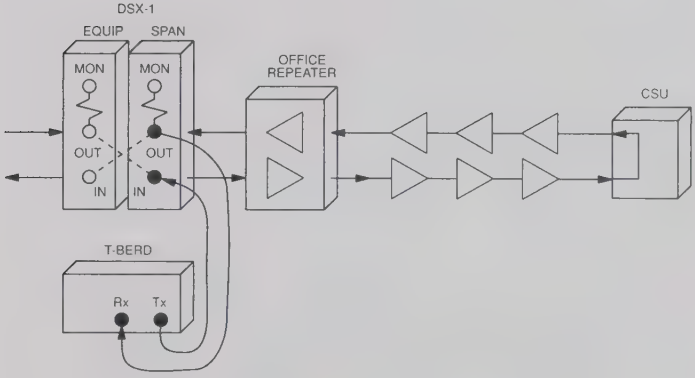
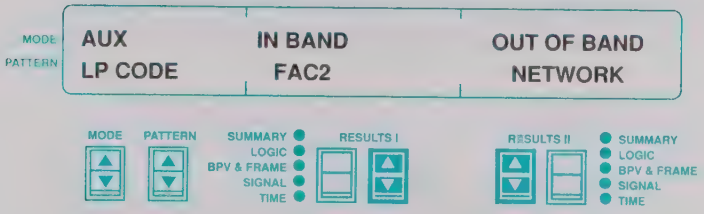


Figure 11
Performing a T1 Loopback Test

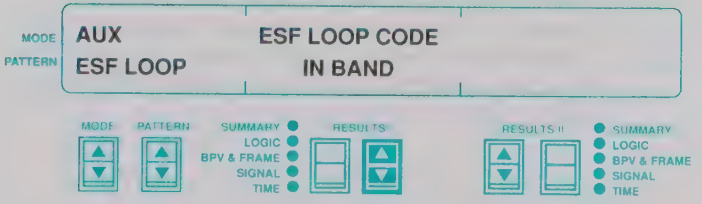
1. **MODE switch**
   Select the AUX mode.

2. PATTERN switch

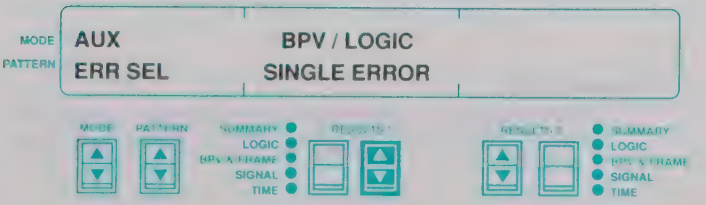
Select AUX LP CODE to set the appropriate loop code.



If testing T1 ESF circuits, select AUX ESF LOOP to set the loop code type.



Select AUX ERR SEL to set the burst duration to insert a single error.



3. **MODE switch**
   Exit the auxiliary function and select the appropriate T1 network framing format.

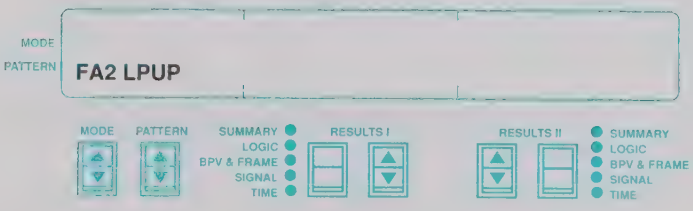
4. **PATTERN switch**
   Select the appropriate test pattern.

5. **TIMING switch**
   Set to INT.

6. **RECEIVE INPUT switch and jack**
   Select the TERM input level and connect a cable between this jack and the span-side DSX-1 OUT jack.

7. **TRANSMIT OUTPUT switch and jack**
   Select the 0dB(DSX) output level and connect a cable between this jack and the span-side DSX-1 IN jack.

8. **LOOP UP switch**
   Press this switch to send the loop-up code. The switch and Loop Up LED illuminate until the loop code is detected. A loop-up code message appears in the display. The test restarts when the loopback is established.



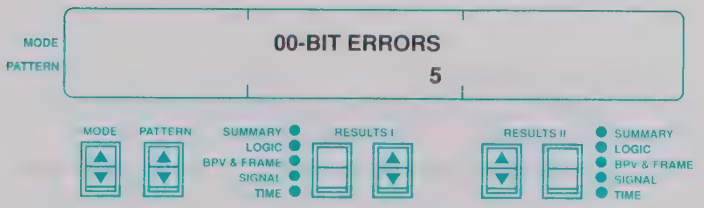
9. **Status LEDs**
   When the loopback is established, these LEDs should illuminate: T1 Pulses, Pattern Sync, Frame Sync, and B8ZS (if applicable).

10. RESULTS I Category switch

Select the SUMMARY category.

11. LOGIC ERROR INSERT switch

Press the switch five times to verify that the logic errors are received and the T1 circuit is looped back.



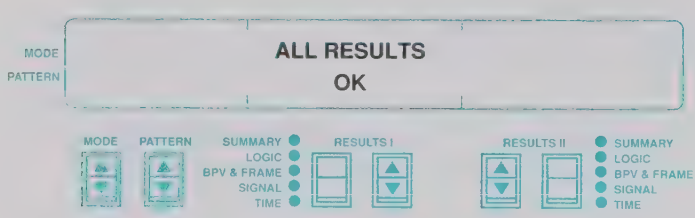
If the loopback is not established, the bit errors do not appear in the display. The failed loopback could be the NIU/CSU not operating correctly, the line from you to the NIU/CSU is bad, or the transmitted loop code is incorrect.

12. RESTART switch

Clear the results and start the test.

13. RESULTS I switches

Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



14. Results interpretation

00-BIT ERRORS, 25-VIOLATIONS, 30-FRM ERRORS, and 32-CRC ERRORS (ESF framing only)

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or a faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument.

40-RX FREQ, Hz

The DS1 received frequency should be 1.544 MHz ±75 Hz. If the frequency is out-of-specification, check the transmission equipment timing or the network synchronization.

41-RX LEVEL (dBdsx)

The received level should be +4 to -4 dBdsx at the terminated DSX-1 OUT jacks. Incorrect levels could be caused by a faulty T1 line card or poor cabling between the DSX jack and the equipment.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate that it is not receiving a T1 signal.

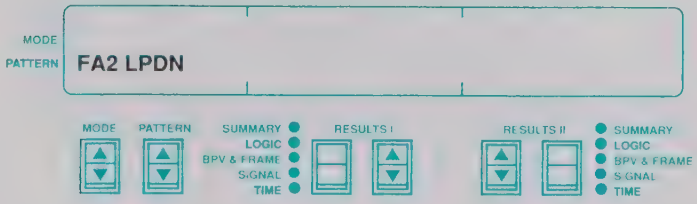
All Ones LED

An Alarm Indication Signal (AIS) indicates that equipment in the signal path is not receiving the T1 signal from the far end. If ALL ONES, MULTIPAT, or BRIDGTAP is being used, the LED illuminates when the ALL ONES pattern is transmitted and received.

Disconnect the T-BERD 209A/211

15. LOOP DOWN switch

Press this switch to send the loop-down code. The switch and Loop Down LED illuminate until the loopback is released. A loop-down code message appears in the display. Disconnect the T-BERD 209A/211 from the span.



10. EMULATING A CSU AT CUSTOMER PREMISES

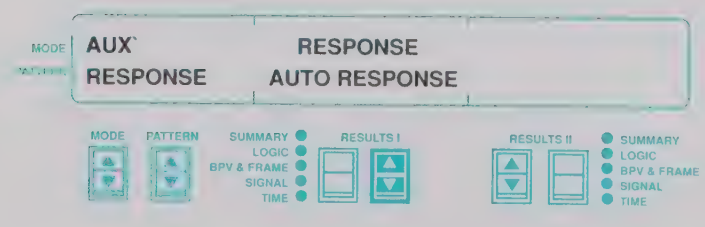
- Verify the span installation.
- Terminate the T1 line and loop simplex current.
- Measure simplex current and T1 level.
- Auto-respond to T1 loop codes.
- Functionally replace an NIU/CSU.

Figure 12 illustrates the T-BERD 209A/211 connected to the span through the NIU and emulating a CSU at the customer premises. The central office requires a test set to be connected to the T1 span to send loop codes and test patterns.

NOTE: One of the functions of the CSU is to complete the current path for powering the regenerative repeaters on the span. HAZARDOUS VOLTAGES EXIST ON THE LINE SIDE OF THE CSU. Local telephone company office alarms may sound when the current path is interrupted. Since telephone companies do not have a uniform policy regarding the disconnection of the CSU from the span, LOCAL TELEPHONE COMPANY INTERVENTION IS STRONGLY RECOMMENDED. Advance notice should be given so that power can be removed from the span before disconnection of the CSU.

1. **MODE switch**
   Select the AUX mode.

2. **PATTERN switch**
   Select AUX RESPONSE to set the loop code response function.



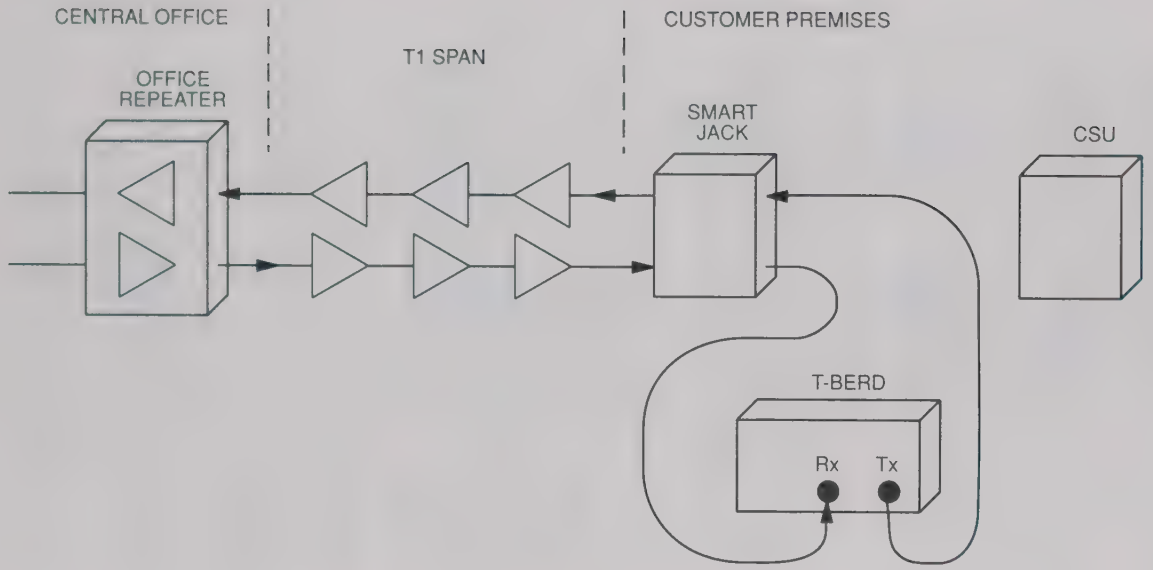
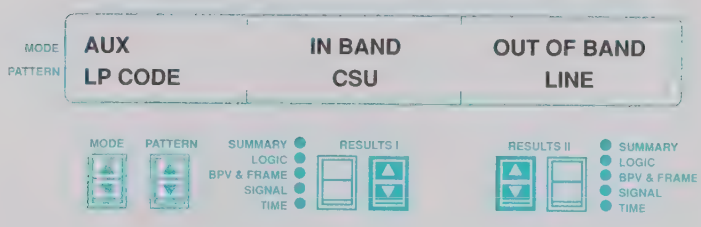
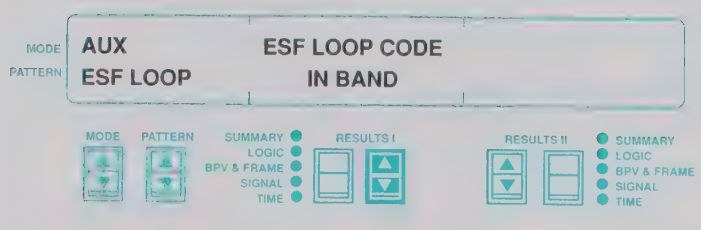


Figure 12
Emulating a CSU at the Customer Premises

Select AUX LP CODE to set the appropriate loop code.



If testing T1 ESF circuits, select AUX ESF LOOP to set the loop code type. The loop code must match the loop code being sent from the central office.



3. **MODE switch**
   Select AUTO mode.

4. **TIMING switch**
   Set to INT.

5. **Central office repeater power supply**
   Disconnect the office repeater power supply from the span being tested.

   WARNING: **HIGH VOLTAGE MAY BE ENCOUNTERED.**

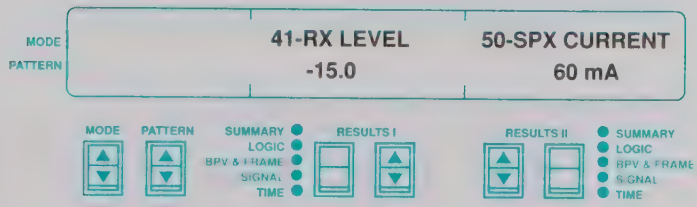
6. **RECEIVE INPUT switch**
   Select the TERM input level.

7. **Transmit and receive connections**
   Connect a cable between the T-BERD 209A/211 and the NIU.

   WARNING: If any T-BERD 209A/211 connector is attached to a powered span line, the line voltage is also present on the associated T-BERD 209A/211 connections. Therefore, do not use the other connections.

8. **Central office repeater power supply**
   Connect the office repeater power supply to the span being tested.

9. **RESULTS switches**
   Select the SIGNAL category. Scroll to the 41-RX LEVEL result in one window and the 50-SPX CURRENT result in the other window.

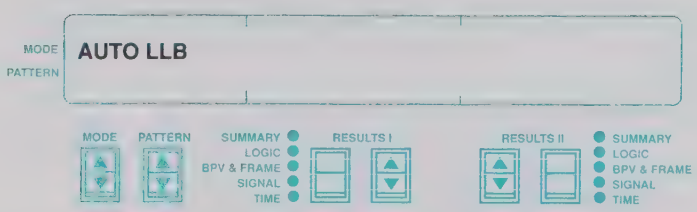


10. **TRANSMIT OUTPUT switch**
    Select the appropriate output level as follows:

    - If the receive level is -15 dBdsx, set the transmit level to 0 dBdsx.
    - If the receive level is -14 to -8 dBdsx, set the transmit level to -7.5 dBdsx.
    - If the receive level is -7.5 dBdsx and above, set the transmit level to -15 dBdsx.

11. **Send CSU loop-up code from central office to T-BERD 209A/211**

The T-BERD 209A/211 responds by establishing an AUTO LLB mode. This internally loops the receiver to the transmitter. The Loop Up LED illuminates when the loop-up code is received. The test restarts when the loopback is established.



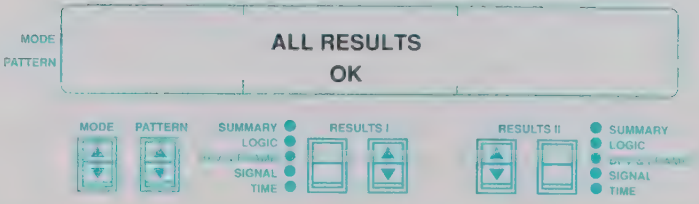
If AUTO LLB does not appear, check that the AUX RESPONSE function is set to AUTO RESPONSE or verify the AUX LP CODE function is set to the correct loop code. Also verify the central office setup.

12. **Loopback and Status LEDs verification**

The loopback is successfully established and these LEDs should illuminate: T1 Pulses, Pattern Sync, Frame Sync, and B8ZS (if applicable).

13. **RESULTS I switches**

Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



14. **Results interpretation**

00-BIT ERRORS, 25-VIOLATIONS, 30-FRM ERRORS, and 32-CRC ERRORS (ESF framing only)

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or a faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument.

50-SPX CURRENT

Depending on the type of office repeater used, the simplex current should read 60, 100, or 140 mA.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate that it is not receiving a T1 signal.

All Ones LED

An Alarm Indication Signal (AIS) indicates that equipment in the signal path is not receiving the T1 signal from the far end. If MULTIPAT or BRIDGTAP is being used, the LED will illuminate when the All Ones pattern is transmitted and received.

Disconnect the T-BERD 209A/211

15. **Send CSU loop-down code from central office to T-BERD 209A/211**

The T-BERD 209A/211 responds by releasing the AUTO LLB mode. The Loop Down LED illuminates when the loop-down code is received. This internally disconnects the receiver from the transmitter. Disconnect the T-BERD 209A/211 from the span.

11. TESTING WITH MULTIPAT AND BRIDGTAP PATTERNS

MULTIPAT™

- Automated test contains five Bellcore approved test patterns to perform a one-step qualification of T1 span lines.
- Includes ALL ONES, 1:7, 2 IN 8, 3 IN 24, and T1-QRSS.

BRIDGTAP™

- Automated test detects the presence of bridge taps on T1 span lines.
- Transmits 21 patterns that are composed of varying degrees of ones and zeros densities.

Figure 13 illustrates the T-BERD 209A/211 configured in a loopback to perform automated MULTIPAT and BRIDGTAP testing.

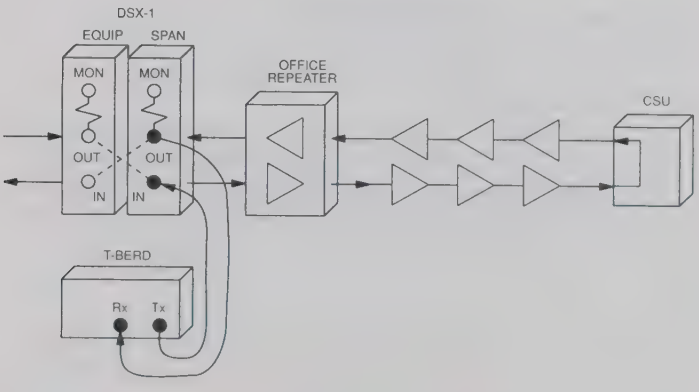
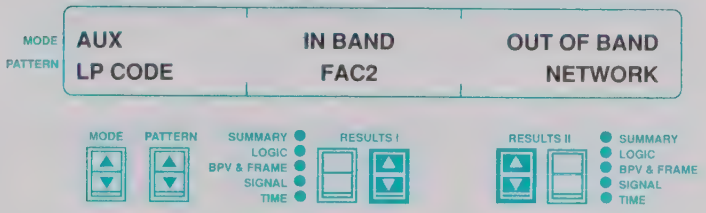


Figure 13
Testing with MULTIPAT and BRIDGTAP

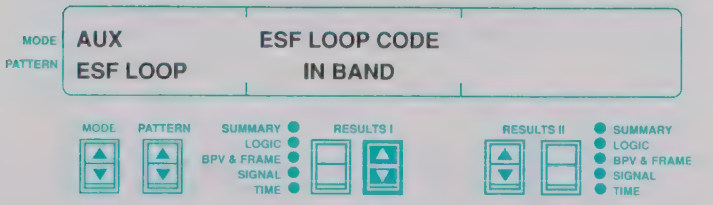
1. **Connect compatible printer (optional)**
   Refer to *Application 1, Generating Printouts*, to connect a printer to the T-BERD 209A/211.

2. **MODE switch**
   Select the AUX mode.

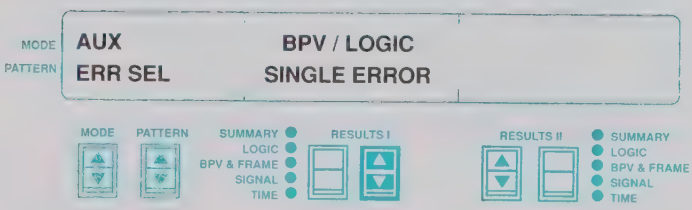
3. **PATTERN switch**
   Select AUX LP CODE to set the appropriate loop code.



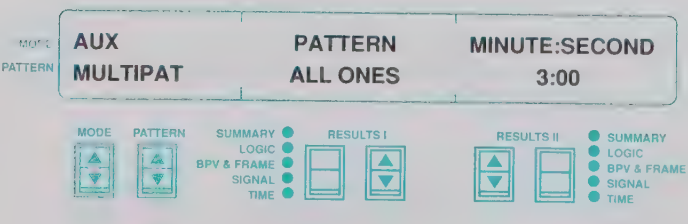
If testing T1 ESF circuits, select AUX ESF LOOP to set the loop code type.



Select AUX ERR SEL to set the burst duration to insert a single error.



For MULTIPAT tests, select AUX MULTIPAT to set the pattern durations.



4. **MODE switch**

Exit the auxiliary function and select the appropriate T1 network framing format.

5. **PATTERN switch**
   Select either the MULTIPAT or BRIDGTAP test pattern.

6. **TIMING switch**
   Set to INT.

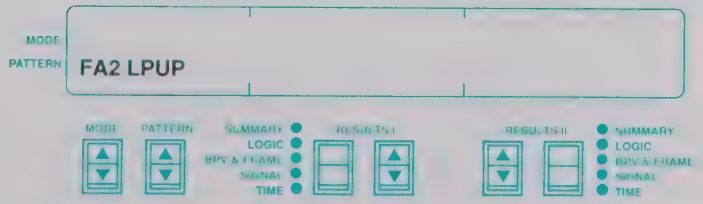
7. **TEST switch**
   Set to CONT.

8. **CODE switch**
   The MULTIPAT test can function with either AMI or B8ZS. The BRIDGTAP test should be performed with AMI selected for best results.

9. **RECEIVE INPUT switch and jack**
   Select the TERM input level and connect a cable between this jack and the span-side DSX-1 OUT jack.

10. **TRANSMIT OUTPUT switch and jack**
    Select the 0dB(DSX) output level and connect a cable between this jack and the span-side DSX-1 IN jack.

11. **LOOP UP switch**
    Press this switch to send the loop-up code. The switch and Loop Up LED illuminate until the loop code is detected. A loop-up code message appears in the display. The test restarts when the loopback is established.



12. Status LEDs

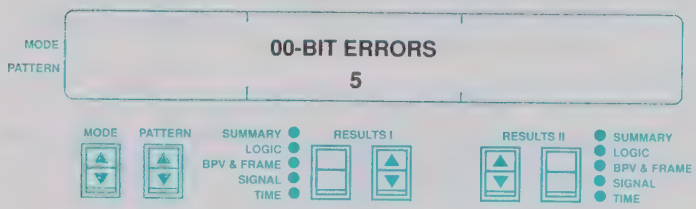
When the loopback is established, these LEDs should illuminate: T1 Pulses, Pattern Sync, Frame Sync, and B8ZS (if applicable). In the PATTERN window, MULTIPAT or BRIDGTAP alternate with the transmitted test pattern. The test pattern appears in lowercase characters.

13. RESULTS I Category switch

Select the SUMMARY category.

14. LOGIC ERROR INSERT switch

Press the switch five times to verify that the logic errors are received and the T1 circuit is looped back.



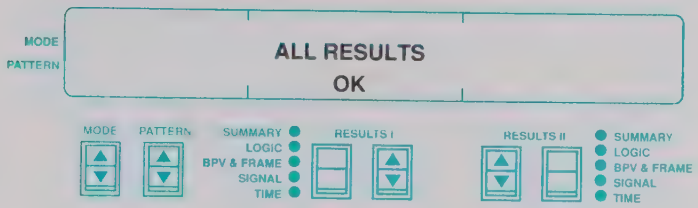
If the loopback is not established, the bit errors do not appear in the display. The failed loopback could be the NIU/CSU not operating correctly, the line from you to the NIU/CSU is bad, or the transmitted loop code is incorrect.

15. RESTART switch

Clear the results and start the test.

16. RESULTS I switches

Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



17. **Results interpretation — SUMMARY category**

ALL RESULTS OK

No errors were detected with the MULTIPAT and BRIDGTAP tests.

PATTERN FAILED (PATTERN NAME)

Test failed at the indicated test pattern.

Errored Results — MULTIPAT Errors

When all or part of the patterns fails, it generally indicates a malfunctioning repeater, multiplexer, or DSX. The span requires further analysis and sectionalization.

Errored Results — BRIDGTAP Errors

When the errors are grouped around a number of patterns it indicates that a bridge tap exists on the span. Sectionalize the span to isolate the bridge tap.

Printing Test Results

18. **PRINT RESULTS switch**

Press this switch to generate a MULTIPAT (see Figure 14) and BRIDGTAP (see Figure 15) results printout.

```
    15MIN PRINT          18:04:50  12 MAR
BIT ERR          1340   ASYN E SEC      802
BER         9.96 E-07   OUT SY SEC        0
SLIPS               0   BPV ERR           0
BPV ER SEC          0   BPV RATE    0 E-09
FRA ER SEC          3   FRA ERR           3
F E RATE       4 E-07   FRA LOS           0
FRA LS SEC          0   SIG LS SC         0
ALARM SEC         372   ELAP TIM  00:15:00
  MULTIPAT RESULTS
PATTERN       BIT ERR   ERR SEC   SYNC SEC
ALL ONES          260   168            175
1:7               271   175            175
2 IN 8            270   167            175
3 IN 24           269   158            175
T1-QRSS           270   134            175
   ALARM/STATUS
ONE DEN HIST       ON   EX ZERO HIST    ON
ALL ONE HIST       ON   T1              ON
PATTERN SYNC       ON   FRAME SYNC      ON
```

Figure 14
Simulated Multipattern Results Printout

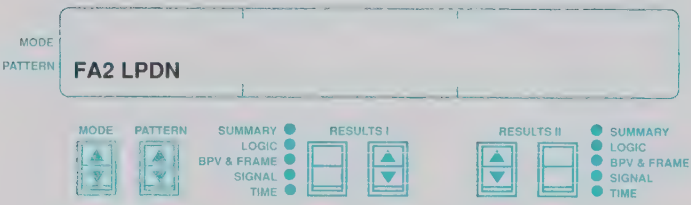
```
     15MIN PRINT            18:04:50  12 MAR
BIT ERR          225423   ASYN E SEC        74
BER            2.13 E-0   OUT SY SEC         0
SLIPS                0   BPV ERR        32301
BPV ER SEC          10   BPV RATE 3.02 E-05
FRA ER SEC          97   FRA ERR         1525
F E RATE     2.12 E-04   FRA LOS            0
FRA LS SEC           0   SIG LS SC          0
ALARM SEC          164   ELAP TIM   00:15:00
BRIDGTAP RESULTS
PATTERN        BIT ERR   ERR SEC   SYNC SEC
ALL ONES             0         0         46
1:1                  0         0         46
1:3                  0         0         46
1:5                  0         0         46
1:6              16123         6         46
1:7              16124         5         46
2:8                  0         0         46
2:9                  0         0         46
2:10                 0         0         46
2:11                 0         0         24
2:12                 0         0         23
2:13                 0         0         23
2:14                 0         0         23
3 IN 18          54600        18         23
3 IN 19          27903        10         23
3 IN 20          44112        14         23
3 IN 21          49785        16         23
3 IN 22              0         0         23
3 IN 23          16776         5         23
3 IN 24              0         0         23
T1-QRSS              0         0         23
    ALARM/STATUS
ONE DEN HIST        ON   EX ZERO HIST    ON
ALL ONE HIST        ON   T1              ON
PATTERN SYNC        ON   FRAME SYNC      ON
```

Figure 15
Simulated Bridge Tap Results Printout

Disconnect the T-BERD 209A/211

19. LOOP DOWN switch

Press this switch to send the loop-down code. The switch and Loop Down LED illuminate until the loopback is released. A loop-down code message appears in the display. Disconnect the T-BERD 209A/211 from the span.



12. MONITORING DS0 CHANNELS
T-BERD T1 CHANNEL MONITOR OPTION REQUIRED

- Display channel signaling information for all 24 channels.
- Monitor DS0 channel through speaker or VF output.

Figure 16 illustrates T-BERD T1 Channel Monitor Option and the T-BERD 209A/211 monitoring the T1 and DS0 signals from the DSX-1 access point.

Connect T1 Channel Monitor To T-BERD 209A/211

1. **T-BERD 209A/211 — turn power off**

2. **Connect coiled cable**
   Connect the T-BERD T1 Channel Monitor coiled cable to the T-BERD 209A/211 15-pin D connector.

T-BERD 209A/211 Test Setup

3. **MODE switch**
   Select AUTO mode.

4. **TIMING switch**
   Set to RECOVD (LOOP).

5. **RECEIVE INPUT switch and jack**
   Select the DSX-MON input level and connect a cable between this jack and the span-side DSX-1 MON jack.

6. **RESTART switch**
   Clear the results and start the test.

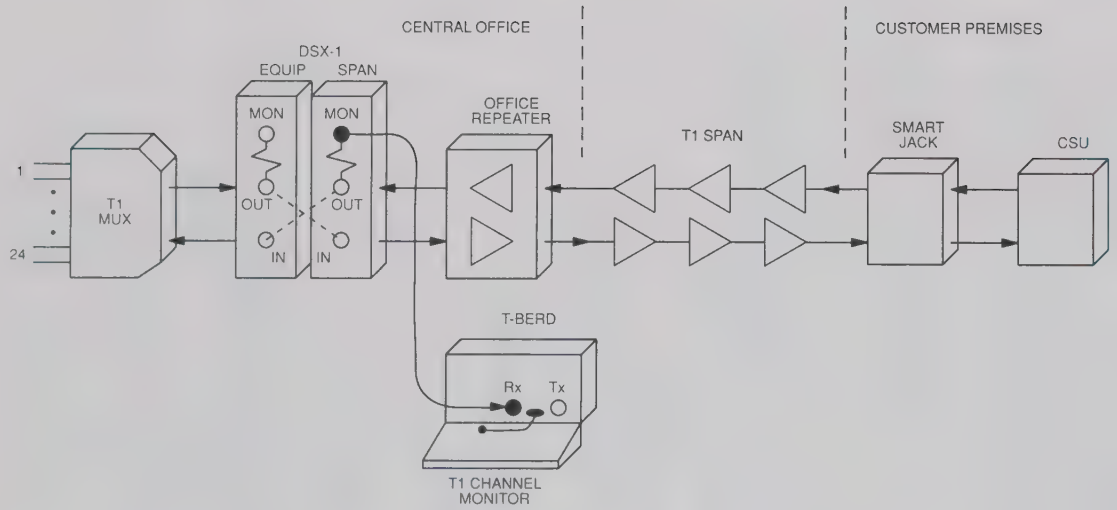


Figure 16
Monitoring T1 and DS0 Signals

7. MODE/PATTERN window

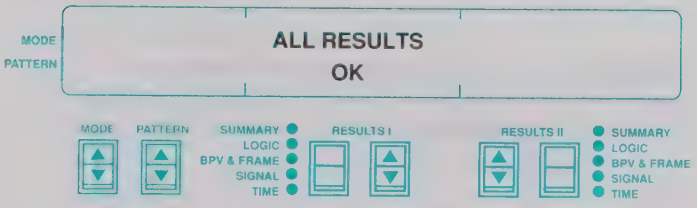
Verify received framing format and pattern. The framing format and pattern (or live) appear in lowercase characters.

8. Status LEDs

These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern Sync (if applicable), and B8ZS (if applicable).

9. RESULTS I switches

Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



10. Results interpretation

25-VIOLATIONS, 30-FRM ERRORS, and 32-CRC ERRORS (ESF framing only)

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or a faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument.

40-RX FREQ, Hz

The DS1 received frequency should be 1.544 MHz ±75 Hz. If the frequency is out-of-specification, check the transmission equipment timing or the network synchronization.

41-RX LEVEL (dBdsx)

The received level should be -20 dBdsx ±1.5 dBdsx at resistor isolated DSX-1 MON jacks. Incorrect levels could be caused by a faulty T1 line card or poor cabling between the DSX jack and the equipment.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate that it is not receiving a T1 signal.

All Ones LED

An Alarm Indication Signal (AIS) indicates that equipment in the signal path is not receiving the T1 signal from the far end. If MULTIPAT or BRIDGTAP is being used,the LED will illuminate when the ALL ONES pattern is transmitted and received.

T-BERD T1 Channel Monitor Option Test Setup

11. **FRAME FORMAT switch**
    Select the appropriate framing format.

12. **CHANNEL SELECT switch**
    Select the desired DS0 channel.

13. **VOLUME control**
    Adjust the control to mid-level.

14. **Results interpretation**
    SIGNALING Display
    Check the signaling for the selected DS0 channel. The AB signaling bits indicate the signaling status (on/off hook, idle, or ringing) for each DS0 channel for all framing formats. The CD signaling bits are only active with ESF framing.

Data Bit LEDs

Monitor the DS0 channel data bits for steady state conditions that can indicate alarms, i.e., Bit 2 is in a steady ON state, Yellow Alarm; all bits are in a steady ON state, Idle signal.

LEVEL (dBm)

Measure the DS0 channel signal level. If the signal level exceeds +3 dBm, the Clipping LED illuminates. On a voice channel, the level varies as the speech pattern changes. It is common to see the Clipping LED flashing. On a data channel, the level should remain constant and the Clipping LED should not flash.

15. **VF OUT jack (optional)**

Connect a VF test set to the Channel Monitor to further analyze the VF signal of the selected DS0 channel.

16. **RS-232 connection (optional)**

Connect a test set (e.g., protocol analyzer) to the Channel Monitor to further analyze either the ESF or SLC datalink or DS0 channel data. Select the output with the **DATALINK/CHANNEL** switch.

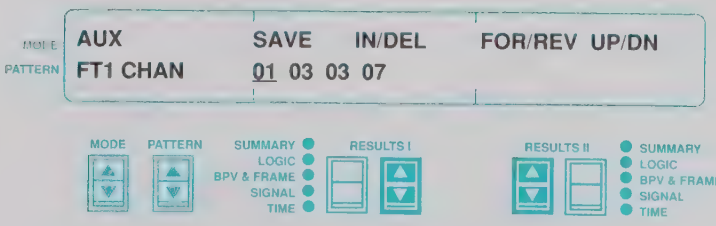
13. MONITORING FT1 PERFORMANCE
FT1 OPTION REQUIRED

- Non-intrusively monitor the FT1 facility.
- Confirm that the contiguous or non-contiguous FT1 signal is properly received by the network equipment.
- Monitor the FT1 signal for BPVs, frame errors, and CRC errors (if applicable).

Figure 17 illustrates the T-BERD 209A/211 monitoring the FT1 signal from the DSX-1 access point.

1. **MODE switch**
   Select the AUX mode.

2. **PATTERN switch**
   Set the AUX FT1 CHAN function for the contiguous or non-contiguous channels.



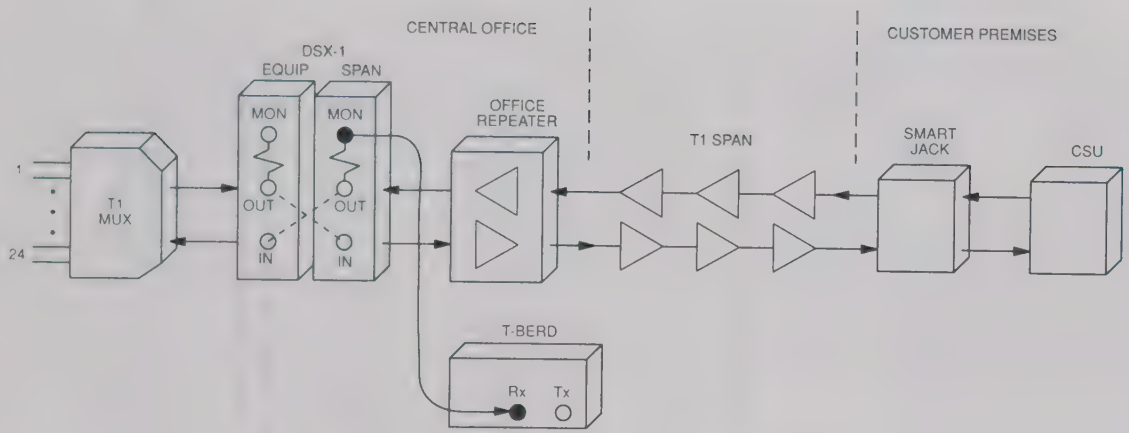
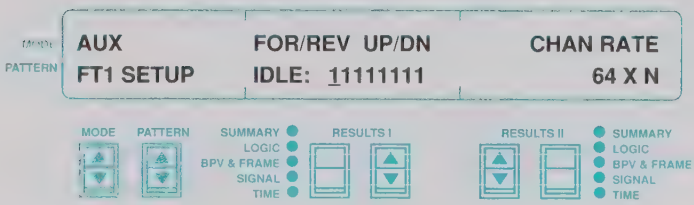


Figure 17
Monitoring FT1 Signal Performance

Set the AUX FT1 SETUP function for the desired idle code and channel rate.



3. **MODE switch**
   Exit the auxiliary functions and select AUTO mode.

4. **TEST switch**
   Set to CONT.

5. **TIMING switch**
   Set to RECOVD (LOOP).

6. **RECEIVE INPUT switch and jack**
   Select the DSX-MON input level and connect a cable between this jack and the span-side DSX-1 MON jack.

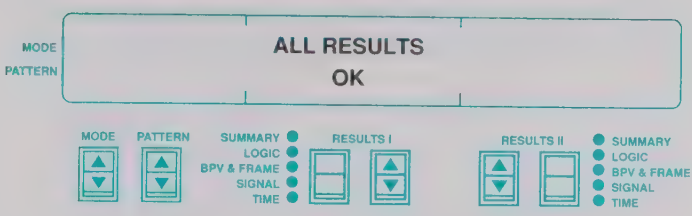
7. **RESTART switch**
   Clear the results and start the test.

8. **MODE/PATTERN window**
   Verify received framing format and pattern. The framing format and pattern (or live) appear in lowercase characters.

9. **Status LEDs**
   These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern Sync (if applicable), and B8ZS (if applicable).

10. RESULTS I switches

Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



11. Results interpretation

25-VIOLATIONS, 30-FRM ERRORS, and 32-CRC ERRORS (ESF framing only)

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or a faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument.

40-RX FREQ, Hz

The DS1 received frequency should be 1.544 MHz ±75 Hz. If the frequency is out-of-specification, check the transmission equipment timing or the network synchronization.

41-RX LEVEL (dBdsx)

The received level should be -20 dBdsx ±1.5 dBdsx at resistor isolated DSX-1 MON jacks. Incorrect levels could be caused by a faulty line card or poor cabling between the DSX jack and the equipment.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate that it is not receiving a T1 signal.

All Ones LED

An Alarm Indication Signal (AIS) indicates that equipment in the signal path is not receiving the T1 signal from the far end. If MULTIPAT or BRIDGTAP is being used, the LED will illuminate when the ALL ONES pattern is transmitted and received.

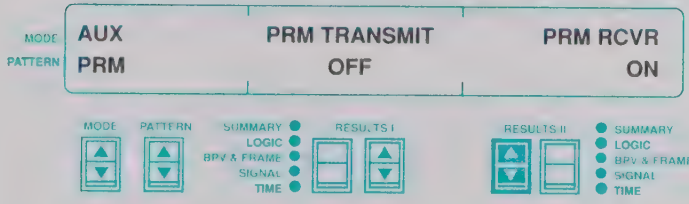
14. MONITORING ESF PRMS
ENHANCED ESF OPTION REQUIRED

- Perform in-service error analysis on T1 ESF circuits.
- Monitor ANSI T1.403 Performance Report Messages (PRMs).

Figure 18 illustrates the T-BERD 209A/211 monitoring a T1 circuit for PRMs from a DSX-1 access point.

1. **MODE switch**
   Select the AUX mode.

2. **PATTERN switch**
   Select AUX PRM and enable the PRM RCVR.



3. **MODE switch**
   Exit the auxiliary function and select the appropriate T1 ESF network framing format or AUTO.

4. **TEST switch**
   Set to CONT.

5. **TIMING switch**
   Set to RECOVD (LOOP).

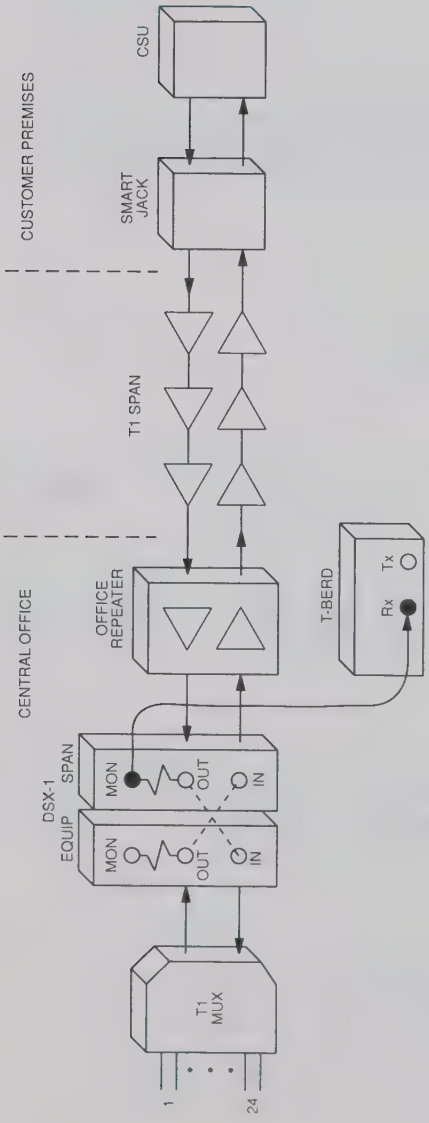


Figure 18
Monitoring T1 ESF Circuit PRMs

6. **RECEIVE INPUT switch and jack**

   Select the DSX-MON input level and connect a cable between this jack and the span-side DSX-1 MON jack.

7. **RESTART switch**

   Clear the results and start the test.

8. **MODE/PATTERN window**

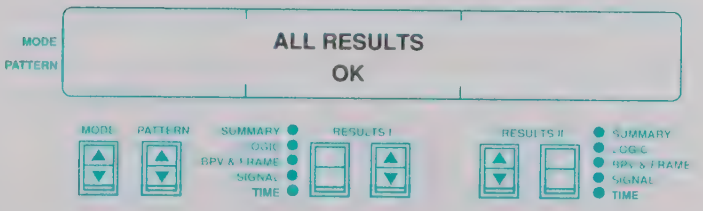
   Verify received framing format and pattern. The framing format and pattern (or live) appear in lowercase characters.

9. **Status LEDs**

   These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern Sync (if applicable), and B8ZS (if applicable).

10. **RESULTS I switches**

    Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



11. **Results interpretation**

    The following results indicate the performance of the received signal at the far-end CSU.

    17-FAR FRM ES

    This result reports on the PRM Frame-Synchronization-Bit Error Event Bit (FE = 1) and indicates the number of seconds in which one or more frame errors occurred in the far-end received signal.

18-FAR FRM SES

This result reports on the PRM Severely-Errored Framing Event Bit (SE = 1) and indicates the number of seconds in which two or more frame errors occurred in less than 3 ms in the far-end received signal. .

19-FAR BPV SEC

This result reports on the PRM Line-Code Violation Event Bit (LV = 1) and indicates the number of seconds in which one or more BPVs occurred in the far-end received signal.

20-FAR SLP SEC

This result reports on the PRM Controlled-Slip Event Bit (SL = 1) and indicates the number of seconds in which controlled slips occurred in the far-end received signal.

21-FAR PRM SEC

This result reports the total number of seconds, since test restart, in which a valid PRM was received.

22-FAR CRC ERR

This result reports on the PRM CRC Error Event Bits (G1 to G6) and indicates the minimum number of CRC errors reported in the following 22-FCRC results.

22-FCRC 1 — This result reports on the first PRM CRC Error Event Bit (G1 = 1).

22-FCRC 2-5 — This result reports on the second PRM CRC Error Event Bit (G2 = 1).

22-FCRC 6-10 — This result reports on the third PRM CRC Error Event Bit (G3 = 1).

22-FCRC11-100 — This result reports on the fourth PRM CRC Error Event Bit (G4 = 1).

22-FCRC101-319 — This result reports on the fifth PRM CRC Error Event Bit (G5 = 1).

22-FCRC>319 — This result reports on the sixth PRM CRC Error Event Bit (G6 = 1).

23-PAY SRC

This result identifies the direction of the PRM according to the PRM Command/Response Bit (C/R) and the Payload Loopback Activated Bit (LB). In end-to-end applications, a customer generated PRM is indicated as CUST (C/R = 0 and LB = 0) and a carrier generated PRM is indicated as CARR (C/R = 1 and LB = 0) in the display. In payload loopback applications, the customer generated PRM is indicated as CUST LOOP (C/R = 0 and LB = 1) when the customer is looped back and the carrier generated PRM is indicated as CARR LOOP (C/R = 1 and LB = 1) when the carrier is looped back.

The following results indicate the performance of the received signal at the near-end terminal.

25-VIOLATIONS, 30-FRM ERRORS, and 32-CRC ERRORS (ESF framing only)

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or a faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument.

40-RX FREQ, Hz

The DS1 received frequency should be 1.544 MHz ±75 Hz. If the frequency is out-of-specification, check the transmission equipment timing or the network synchronization.

41-RX LEVEL (dBdsx)

The received level should be -20 dBdsx ±1.5 dBdsx at resistor isolated DSX-1 MON jacks. Incorrect levels could be caused by a faulty T1 line card or poor cabling between the DSX jack and the equipment.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate that it is not receiving a T1 signal.

All Ones LED

An Alarm Indication Signal (AIS) indicates that equipment in the signal path is not receiving the T1 signal from the far end. If MULTIPAT or BRIDGTAP is being used, the LED will illuminate when the ALL ONES pattern is transmitted and received.

15. RETRIEVING ESF CIRCUIT PERFORMANCE DATA
ENHANCED ESF OPTION REQUIRED

- Retrieve ESF circuit performance data from the NIU/Performance Monitor.
- Clear ESF circuit performance data from the NIU/Performance Monitor memory.

Figure 19 illustrates the T-BERD 209A/211 connected to a T1 ESF circuit at the DSX-1 access point to retrieve circuit performance data from the NIU/Performance Monitor.

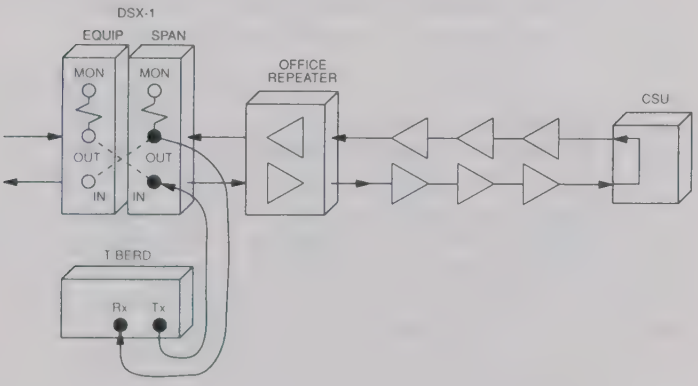


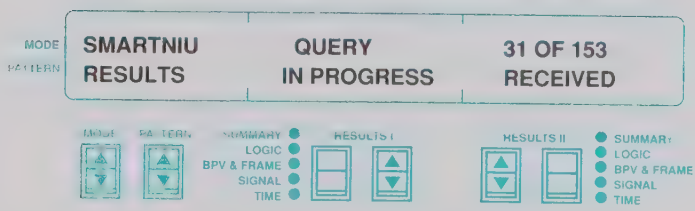
Figure 19
Retrieving ESF Circuit Performance Data

1. **Loop Up the NIU/Performance Monitor**
   Perform Steps 1 through 12 of Application 9 Performing a T1 Loopback. This procedure loops back the NIU/Performance Monitor in preparation for retrieving the stored messages.

2. **MODE switch**
   Select the SMARTNIU mode.

3. **PATTERN switch**
   Select the RESULTS position to enable the Query function.

4. **RESTART switch**
   Press to activate the Query function. The display identifies the number of messages as they are being retrieved from the NIU/Performance Monitor and the total number of messages stored in the NIU/Performance Monitor.



5. **Query function verification**
   When the Query function stops, one of the following messages is displayed. If a *QUERY FAILURE* message is displayed, check the test setup connections and repeat the test.

   QUERY COMPLETE/ALL DATA OK — indicates Query function is complete with no errors reported.

   QUERY COMPLETE/PARTIAL DATA OK — indicates the Query function is complete, but not all the stored messages were retrieved. That there were no error messages in the retrieved messages.

   QUERY COMPLETE/ERRORS DETECTED — indicates Query function is complete with one or more errors reported.

QUERY FAILURE/NO DATA AVAILABLE — indicates the Query function failed with no data retrieved. Query failure was caused by loss of signal, loss of frame, excessive re-transmission of a message, timeout of a response to a query message, or loss of power.

QUERY FAILURE/PARTIAL DATA OK — indicates the Query function failed with some messages retrieved. The retrieved data reported no errors. Query failure was caused by loss of signal, loss of frame, excessive re-transmission of a message, timeout of a response to a query message, or loss of power.

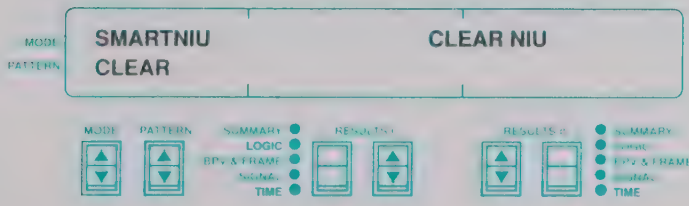
QUERY FAILURE/ERRORS DETECTED — indicates the Query function failed with some messages retrieved. The retrieved data included error messages. Query failure was caused by loss of signal, loss of frame, excessive re-transmission of a message, timeout of a response to a query message, or loss of power.

6. Generate a printout

If the data retrieval was successful and error messages were detected, press the **PRINT** switch RESULTS position to generate a Results printout that includes a SMART NIU results printout. The SMART NIU results printout lists the NIU/Performance Monitor messages retrieved in periodic reports of both A-Z (CO to NIU) and Z-A (NIU to CO) directional results. These periodic reports include a Current Hour Report, 24 History Hour Reports (Hour 01 through Hour 24), a Current Day Report, and 7 History Day Reports (Day 01 through Day 07).

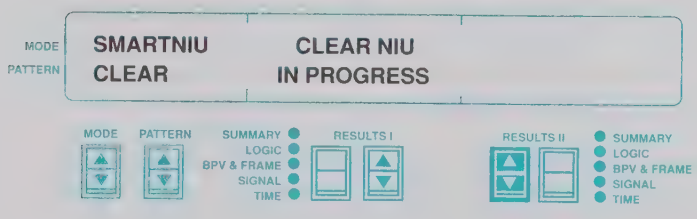
7. PATTERN switch

If the data retrieval was successful and complete, prepare to clear the Performance Monitor memory by selecting CLEAR with the **PATTERN** switch.



8. Activate the Clear function

Press the **RESULTS II Results** switch to activate and clear the recorded messages from the NIU/Performance Monitor. The Clear Performance Monitor process takes approximately ten seconds.



9. Results interpretation

Once the Clear Performance Monitor process is complete, the display reports the status of the Clear function as follows:

NIU CLEARED — indicates all results are cleared from the NIU/Performance Monitor.

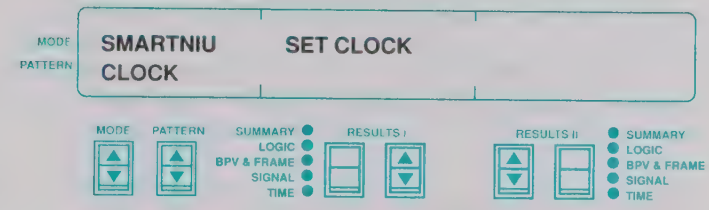
CLEAR NIU FAILED — indicates the Clear function failed to clear the NIU/Performance Monitor of all messages. This could be the result of poor connections. Check the T1 circuit connections and try again.

10. Verify date and time on printout

Use the AUX DATE and AUX TIME functions to verify the T-BERD 209A/211 date and time are correct. If not, use the AUX DATE or AUX TIME function to set the correct values. Compare the date and time for the Current Hour Report to the verified date and time on the T-BERD 209A/211. If the Current Hour Report time does not agree with the verified date and time, perform the following steps to reset the NIU/Performance Monitor clock.

11. PATTERN switch

Prepare to reset the NIU/Performance Monitor clock by selecting CLOCK.



12. RESULTS II Results switch

Press the **RESULTS II Results** switch to activate the Set Clock function.

13. Results interpretation

Once the Set Clock function is complete, the display reports the status as follows:

CLOCK SET — indicates the Set Clock function has set the NIU/Performance Monitor time and date to match the T-BERD 209A/211's time and date.

SET CLOCK FAILED — indicates the Set Clock function failed to set the time and date to match the T-BERD 209A/211's time and date. This could be the result of poor connections. Check the T1 circuit connections and try again.

16. TESTING INTELLIGENT REPEATER SPANS
ADVANCED BERT OPTION REQUIRED

- Sectionalize addressable repeater spans by transmitting appropriate loop codes from the central office.

Figure 20 illustrates the T-BERD 209A/211 connected at a DSX-1 access point to sectionalize an intelligent repeater span.

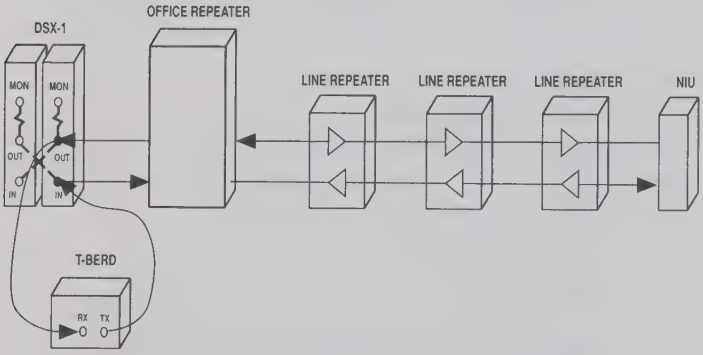


Figure 20
Intelligent Repeater Span Test Setup

1. **MODE switch**
   Set to T1 D4, T1 ESF, or T1 SLC. The addressable repeater loop-up and loop-down codes must be sent in a framed T1 signal.

2. **PATTERN switch**
   Select the appropriate test pattern.

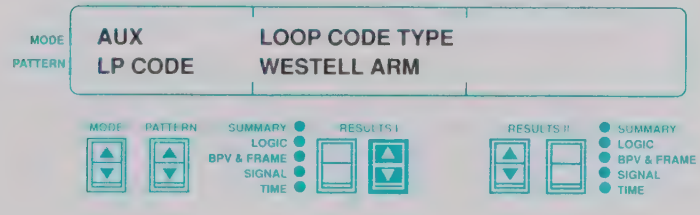
3. **TIMING switch**
   Set to INT.

4. **RECEIVE INPUT switch and jack**
   Select the TERM input level and connect a cable between this jack and the span-side DSX-1 OUT jack.

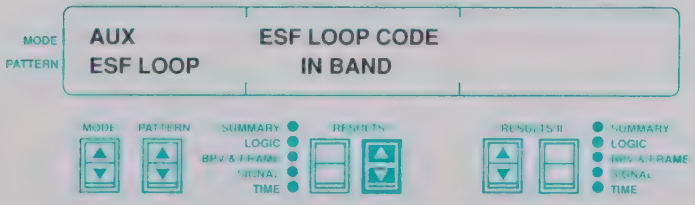
5. **TRANSMIT OUTPUT switch and jack**
   Select the 0db(DSX) output level and connect a cable between this jack and the span-side DSX-1 IN jack.

6. **MODE switch**
   Select the AUX mode.

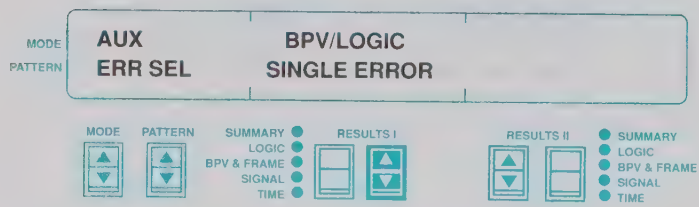
7. **PATTERN switch**
   Select AUX LP CODE to set the appropriate arming code. If the span is composed of XEL repeaters, go to Step 17.



If testing T1 ESF circuits, select AUX ESF LOOP to set the loop code type.



Select AUX ERR SEL to set the burst duration to insert a single error.



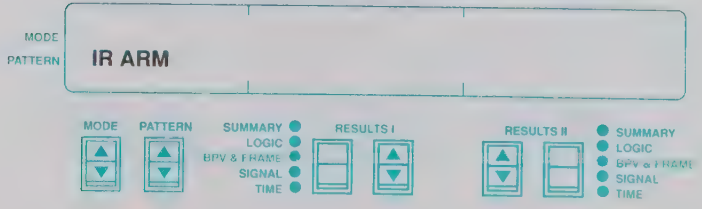
8. **MODE switch**

Exit the auxiliary function.

9. **LOOP UP switch**

Press this switch to send the arming/NIU loop-up code. The switch and Loop Up LED illuminate until the loop code is detected. A loop-up code message appears in the PATTERN window. This arms the span's addressable repeaters and provides a loopback at the NIU.

If the switch LED remains illuminated, the span problem may be preventing the loop code from reaching the NIU or returning to the T-BERD 209A/211. Go to the *Addressable Repeater Span Sectionalization* procedure and attempt to loop up the mid-span addressable repeater.



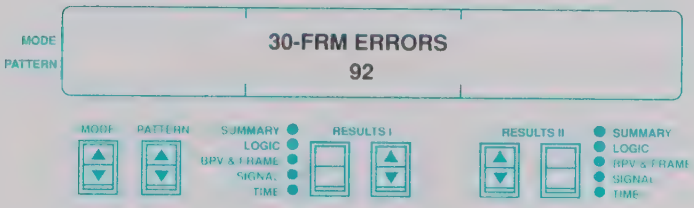
10. Status LEDs

When the NIU loopback is established, these LEDs should illuminate: T1 Pulses, Pattern Sync, Frame Sync, and B8ZS (if applicable).

11. RESULTS I switches

Check the SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears, and no further testing of the span is necessary. Go to the *Disconnect the T-BERD 209A/211* procedure.

If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required. Record the types of errors to determine the symptoms of the span problem.



12. Symptoms identification

00-BIT ERRORS, 25-VIOLATIONS, 30-FRM ERRORS, and CRC ERRORS (ESF framing only)

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or a fault multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the T-BERD 209A/211.

40-RX FREQ, Hz

The DS1 received frequency should be 1.544 MHz ±75 Hz. If the frequency is out-of-specification, check the transmission equipment timing or the network synchronization.

41-RX LEVEL (dBdsx)

The received level should be +4 to -4 dBdsx at the terminated DSX-1 OUT jacks. Incorrect levels could be caused by a faulty T1 line card or poor cabling between the DSX jack and the equipment.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate it is not receiving a T1 signal.

All Ones LED

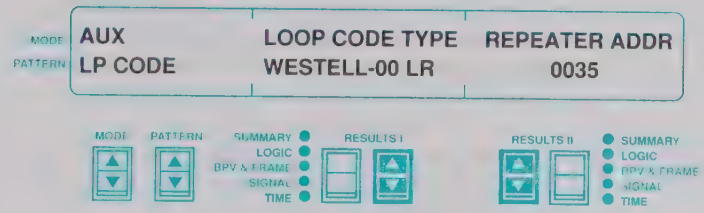
An Alarm Indication Signal (AIS) indicates equipment in the signal path is not receiving the T1 signal from the far end. If ALL ONES, MULTIPAT, or BRIDGTAP is being used, the LED illuminates when the ALL ONES pattern is transmitted and received.

Addressable Repeater Span Sectionalization

1. **MODE switch**
   Select the AUX mode.

2. **PATTERN switch**
   Select AUX LP CODE to set the appropriate addressable repeater type and address to match the mid-span addressable repeater.

   NOTE: If testing lasts longer than 30 minutes on a Westell model 3130-56 office repeater, a Westell model 3150-56 line repeater, or any Teltrend line repeater, set the LOOP CODE TYPE to WESTELL-56 OR/AUTO TIMEOUT DISABLE, WESTELL-56 LR/AUTO TIMEOUT DISABLE, or TELTREND LR/AUTO TIMEOUT DISABLE, as appropriate. Press the **LOOP UP** switch to send the loop code that disables the automatic timeout feature.



3. **MODE switch**

   Exit the auxiliary function.

4. **LOOP UP switch**

   Press this switch to send the addressable repeater loop-up code to the mid-span repeater. The switch and Loop Up LED illuminate until the loop code is detected. This loops back the signal at the mid-span addressable repeater.

   If the switch LED remains illuminated, the span problem may be preventing the loop code from reaching the mid-span addressable repeater or from returning to the T-BERD 209A/211. Go to Step 8 and select a repeater closer to the CO.

5. **Status LEDs verification**

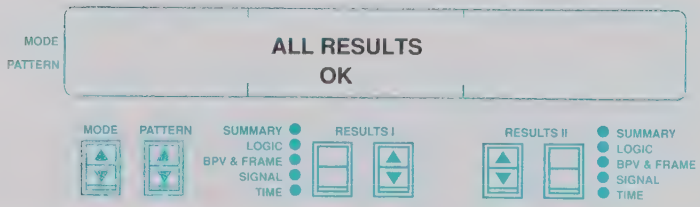
   These LEDs should illuminate: T1 Pulses, Pattern Sync, Frame Sync, and B8ZS (if applicable).

6. **Results interpretation**

   Check the SUMMARY category. If the identified symptoms are detected, the problem is between the Central Office (CO) and the looped-back mid-span repeater.

If the T-BERD 209A/211 was unable to loop back the signal at the addressed repeater, the span problem is probably between the CO and the addressed repeater. The span problem could be blocking the loop codes. Go to

If the message *ALL RESULTS OK* is displayed and no Alarm LEDs are illuminated, the problem is between the looped-back mid-span repeater and the customer premises.



7. **LOOP DOWN switch**

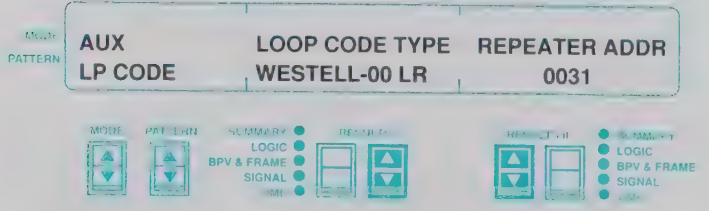
   Press this switch to send the addressable repeater loop-down code to the mid-span repeater.

8. **Determine new addressable repeater address**

   Select a new addressable repeater to be looped back based on the results in Step 7.

9. **MODE, PATTERN, and RESULTS switches**

   Select the AUX LP CODE function. Set the REPEATER ADDR parameter to match the selected addressable repeater.



10. **MODE switch**

Exit the auxiliary function.

11. **LOOP UP switch**

Press this switch to send the addressable repeater loop-up code to the selected repeater. The switch and Loop Up LED illuminate until the loop code is detected.

If the T-BERD 209A/211 was unable to loop back the signal at the addressed repeater, the span problem is probably between the CO and the addressed repeater. The span problem could be blocking the loop codes. Return to Step 7.

12. **Results interpretation**

If the looped-back repeater is closer to the CO and errors are still detected, the problem is between the Central Office (CO) and the looped-back repeater. If the looped-back repeater is closer to the CO and no errors are detected, the problem is between the two looped-back repeaters.

If the looped-back repeater is closer to the customer premises and errors are detected, the problem is between the two looped-back repeaters. If the looped-back repeater is closer to the customer premises and no errors are detected, the problem is between the looped-back repeater and the customer premises.

13. **Repeat steps until problem is isolated**

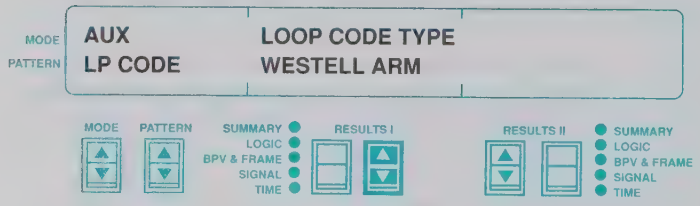
Repeat Steps 7 through 12 until the problem's location has been isolated between two or three repeaters. Now the problem's exact location can be determined by accessing only one or two repeater housings.

14. **LOOP DOWN switch**

Press this switch to loop down the addressable repeater.

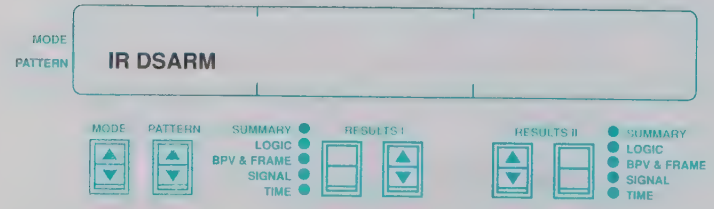
Disconnect the T-BERD 209A/211

1. **MODE, PATTERN, and RESULTS switches**
   Select AUX LP CODE to set the appropriate arming/disarming code.



2. **MODE switch**
   Exit the auxiliary function.

3. **LOOP DOWN switch**
   Press this switch to send the disarming/NIU loop-down code. The switch and Loop Down LED illuminate until the loopback is released. A loop-down code message appears in the display. Disconnect the T-BERD 209A/211 from the span.



TESTING CABLE PAIRS

TESTING FOR SHORTS, OPENS, AND BRIDGE TAPS

17. TESTING FOR SHORTS, OPENS, AND BRIDGE TAPS
TDR OPTION REQUIRED

- Test twisted-pair copper wire for shorts, opens, bridge taps, etc.

Figure 21 illustrates the T-BERD 209A/211 connected to a cable pair to test the line with the TDR.

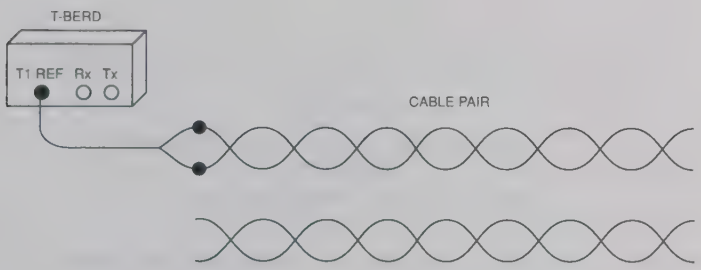


Figure 21
Testing for Shorts, Opens, and Bridge Taps

Testing a Cable Pair with the TDR

Figure 22 illustrates how the TDR GRAPH would appear after the initial test of the cable pair. The GRAPH indicates a bridge tap at 2042 feet (position 1) and an OPEN at 5339 feet (position 2). By selecting Fault 2 from the TDR RESULTS display and pressing PRINT GRAPH again, the magnified trace of Fault 2, shown in Figure 23, can be more clearly viewed. The trace at Fault 2 has the characteristics of a short. To verify the actual fault at Fault 2, remove the bridge tap and repeat the TDR test. Figure 24 clearly identifies the fault as a short, and with the bridge tap removed, the short becomes the first fault down the cable pair.

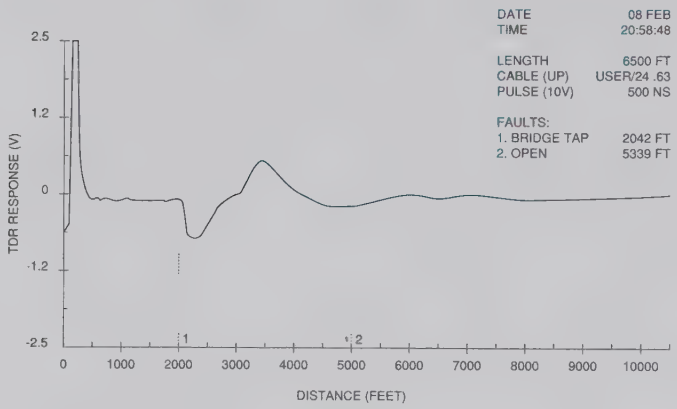


Figure 22
Initial TDR Test Result Graph

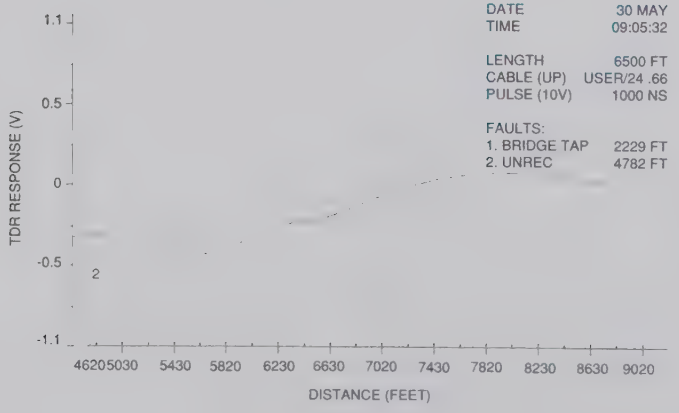


Figure 23
Magnified TDR Graph

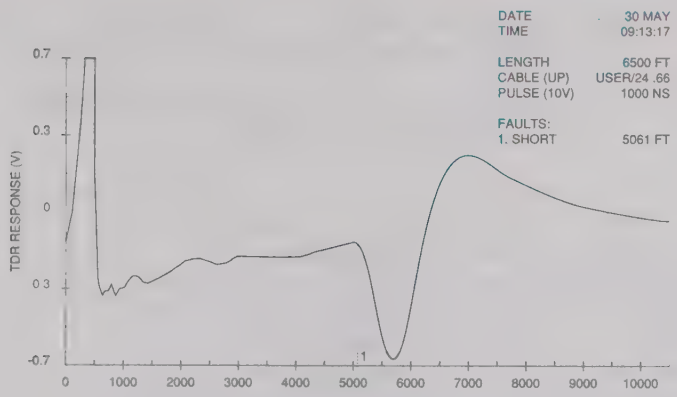


Figure 24
Verifying the Second Cable Pair Fault

1. **Cable pair preparation**
   - Remove all known T1 impairments (bridge taps, coils, etc.).
   - Open both ends of the cable pair. On repeatered spans, remove the repeater and simplex current.

   NOTE: The TDR cannot look past hard opens or shorts and multiple faults on a cable pair reduce the effectiveness of the TDR. Therefore, as the faults are located they should be repaired and the line retested.

2. **Connect compatible printer (optional)**
   Refer to *Application 1, Generating Printouts*, to connect a printer to the T-BERD 209A/211.

3. **MODE switch**
   Select TDR mode.

4. **PATTERN switch**
   Select TDR SETUP menu.

5. **RESULTS I Category switch**
Select CABLE type and PR. VEL for the cable pair being tested.

NOTE The selected CABLE type must match the cable being tested to obtain accurate results.

CABLE	PR. VEL	Description
PIC/22	.67	22 gauge PIC wire.
PIC/24	.66	24 gauge PIC wire.
PIC/26	.65	26 gauge PIC wire.
JELL/22	.62	22 gauge jelly-filled insulated wire.
JELL/24	.61	24 gauge jelly-filled insulated wire.
JELL/26	.60	26 gauge jelly-filled insulated wire.
PULP/22	.71	22 gauge paper-pulp insulated wire.
PULP/24	.70	24 gauge paper-pulp insulated wire.
PULP/26	.68	26 gauge paper-pulp insulated wire.
USER/22	.40 - .99	When the wire gauge and PR. VEL are known for a cable not listed, select the wire gauge with the **RESULTS I Category** switch and PR. VEL with the **RESULTS I Results** switch in 0.01 steps.
USER/24	.40 - .99	
USER/24	.40 - .99	
DEFAULT	.66	If the PR. VEL and CABLE type are unknown, select DEFAULT.

6. **RESULTS II Results switch**
Select LENGTH: 1000, 3000, or 6500 feet. Select AUTO if cable length is unknown.

7. **RESULTS II Category switch**
Toggle display to NO REF (if not already NO REF) to clear reference trace buffer.

8. **T1 REF (TDR) jack**
   Connect test cable between this jack and the cable pair.

9. **RESTART switch**
   Press to start TDR test.

10. **Test verification**
    - *TESTING* flashes in PATTERN window.
    - *RESULTS: NOT AVAILABLE* appears in RESULTS I window.
    - When test is completed, the fault and distance information appears in the RESULTS I window. Up to four faults can be identified at one time.

11. **Cable pair fault analysis**
    - If *FAULT 1: OPEN AT xxxx FEET* appears and the distance is the end of the cable pair, the pair is good. This ends the test.
    - If *FAULT 1: OPEN (or SHORT) AT xxxx FEET* appears and the distance is *not* the end of the cable pair, the pair has a short or open at the indicated distance. Clear the fault and repeat the procedure.
    - If *FAULT 1: NONE* appears, no fault is detected. Either the cable pair is too long for the distance being tested or it is terminated with no impedance mismatch.
    - If *FAULT 1: B-TAP AT xxxx FEET* appears, the pair has a bridge tap at the indicated distance. Clear the fault and repeat the procedure.
    - If *FAULT 1: UNREC AT xxxx FEET* appears, the pair has an unrecognized fault at the indicated distance. Use the TDR printout to identify the fault. Clear the fault and repeat the procedure.

12. **Generate a printout**

Go to *Print a Single Trace TDR Graph* to generate a single trace GRAPH. Go to *Print a Dual Trace TDR Graph* to generate a dual trace GRAPH. Go to *Print TDR Results and Setup* to generate the TDR results and setup printout.

Print a Single Trace TDR Graph

1. **PATTERN switch**

Select the TDR SETUP menu and verify NO REF is displayed.

2. **PATTERN switch**

Select TDR RESULTS and verify PRINT GRAPH is displayed.

3. **RESULTS II Category switch**

Press this switch to PRINT GRAPH. A single trace graph is printed (see Figure 25).

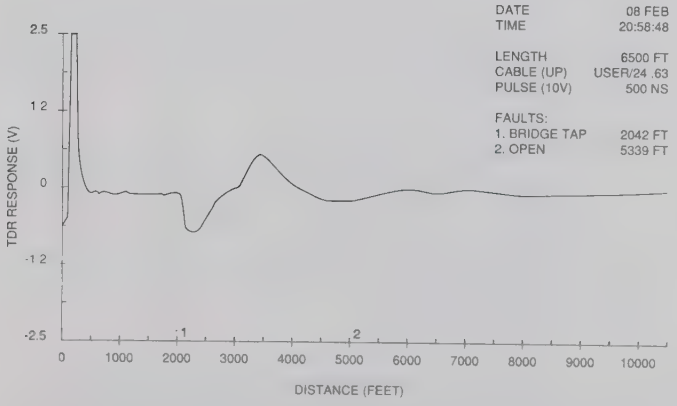


Figure 25
Single Trace TDR Graph

Print a Dual Trace TDR Graph

1. **PATTERN switch**
   Select the TDR SETUP menu and verify NO REF is displayed.

2. **RESULTS II Category switch**
   Press this switch to store the current trace and verify REF STORED appears.

3. **Select another cable pair and press RESTART switch**
   The second cable pair is tested and the results appear in the display.

4. **RESULTS II Category switch**
   When the TDR RESULTS appear, press this switch to PRINT GRAPH. A dual trace graph is printed (see Figure 26).

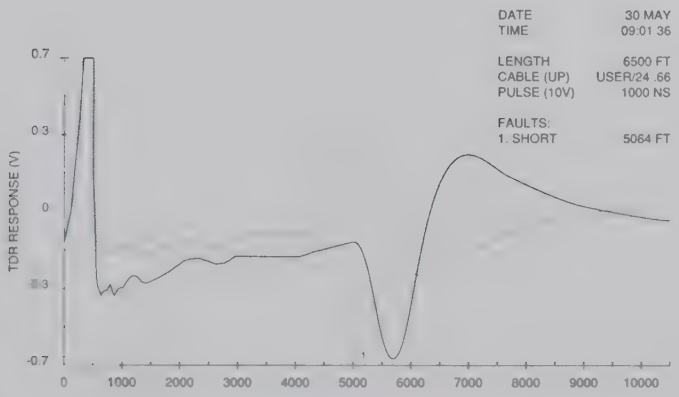


Figure 26
Dual Trace TDR Graph

Print TDR Results and Setup

1. **PRINT switch**
   Press the RESULTS side to print the TDR RESULTS. Press the CONTROLS side to print the TDR SETUP (see Figure 27).

```
TDR CONTROLS PRINT    08:27:50      28 FEB
   SETTINGS:
     LENGTH (FT)      AUTO
     CABLE  (VP)      DEFAULT .66
     REFERENCE        NO



TDR RESULTS PRINT     08:28:27      28 FEB
  FAULTS:
1. B-TAP at    2580 feet
2. OPEN  at    3640 feet
```

Figure 27
TDR Controls and Results Printouts

TESTING NEWLY INSTALLED T1 SPANS

TESTING FROM THE MDF

TESTING FROM MID-SPAN

18. TESTING FROM THE MDF
T-BERD REPEATER POWER SUPPLY REQUIRED

- Power a T1 span line from the main distribution frame (MDF).
- Measure the current and voltage across a T1 span line.
- Provide the T-BERD 209A/211 access to the T1 span line from the MDF.

WARNING: It is of the upmost importance that the T-BERD Repeater Power Supply be operated by qualified technicians in accordance with the safety warnings and instructions contained in this manual and printed on the front panel of the unit. Failure to do so could result in serious personal injury. Carefully read the safety information in Section 4 of the *T-BERD 209A/211 Reference Manual* before operating the T-BERD Repeater Power Supply.

Figure 28 illustrates the test setup for the T-BERD Repeater Power Supply and T-BERD 209A/211 at the MDF.

T-BERD Repeater Power Supply Test Setup

WARNING: Do not apply power to the T-BERD Repeater Power Supply until instructed to do so. When power is applied to the T-BERD Repeater Power Supply there is a 350 VDC potential across the terminals, which can cause personal injury.

1. **Connect Mainframe Interconnect Cable**
   Connect the T-BERD Repeater Power Supply Mainframe Interconnect Cable to the T-BERD 209A/211 15-pin D connector.

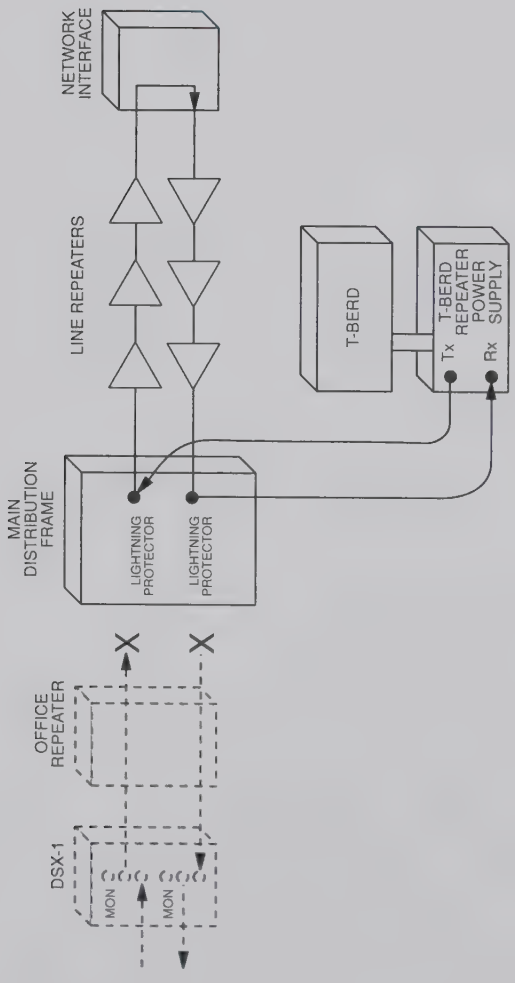


Figure 28
Test Setup at the MDF

2. **Connect the dual WECO 310 or bantam test cords**

   Insert dual WECO 310 or dual bantam test cords into the appropriate transmit and receive jacks on the T-BERD Repeater Power Supply front panel. Connections to the central office distribution frame should be made with a W4CJ test access cord for 303-type protection blocks or a W4BR test access cord for 302-type and 308-type protection blocks.

3. **Remove MDF lightning protectors**

   Remove the MDF lightning protectors from the cable pairs being tested. Insert the transmit and receive cord connectors from the T-BERD Repeater Power Supply into the positions vacated by the lightning protectors.

4. **60 mA 100 mA 140 mA switch**

   Select the appropriate current level. The appropriate current setting is determined by the type of repeaters in the circuit being tested. The typical selection is 60 mA.

5. **T-BERD Repeater Power Supply AC power**

   Connect a power cord from the T-BERD Repeater Power Supply into a 120 VAC power outlet. Make sure the **AC Power** switch is turned OFF.

6. **Apply power to the T-BERD Repeater Power Supply**

   When power is applied to the T-BERD Repeater Power Supply, the red High Voltage LED flashes. This indicates that current is passing through the T-BERD Repeater Power Supply. If the red High Voltage LED continues to flash, the current path can not be established, check for an open circuit or other possible wiring fault.

   When the circuit current path is established, the red High Voltage LED remains on continuously. The VOLTAGE and CURRENT displays reflect the current and voltage on the circuit.

To determine if the measured voltage is correct for the span being tested, calculate the expected span line voltage drop with the following formula. The V_{rpt} and V_{drop} can be found in Tables 2 and 3 respectively.

Total V_{drop} = (# repeaters X V_{rpt}) + (V_{drop} X kft of cable)

- If the transmit and receive connections are reversed, the measured voltage will be much less than the expected voltage. Typically, V_{rpt}, when current is reversed, is between 1 and 2 volts.

- Allow for any extra voltage drop required for office repeaters and NIUs. The typical voltage drop for transmission devices is 8 to 16 volts each.

- Allow for additional CSU voltage drops of 14 to 24 volts.

Table 2
Typical Repeater Voltage Drop

	Voltage Drop/Repeater (V_{rpt})		
Repeater Type	**60 mA**	**100 mA**	**140 mA**
238 A/B	7.0	7.1	7.2
239 A/B	7.6	8.2	8.7
239E	8.4	9.6	10.7

Table 3
Typical Cable Gauge Voltage Drop

	Voltage Drop/kft (V_{drop})		
Cable Gauge	**60 mA**	**100 mA**	**140 mA**
26	2.7	4.5	6.3
24	1.7	2.8	4.0
22	1.1	1.8	2.6
19	0.5	0.8	1.2

T-BERD 209A/211 Test Setup

7. **T-BERD 209A/211 AC power**
   Apply power to the T-BERD 209A/211.

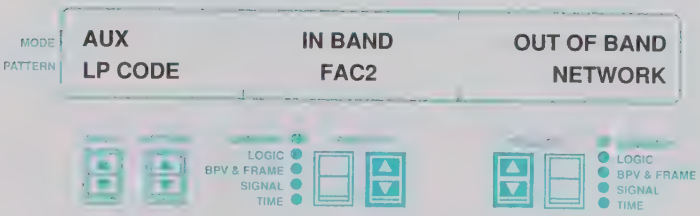
8. **RECEIVE INPUT switch**
   Set the **RECEIVE INPUT** switch to the TERM position.

9. **TRANSMIT OUTPUT switch**
   Set the **TRANSMIT OUTPUT** switch to achieve the desired line build-out. The typical setting is -7.5 dB. The desired setting may be calculated such that the sum of the signal level measurement (41-RX LEVEL) and the selected line build-out is between -15 dBdsx and -22.5 dBdsx.

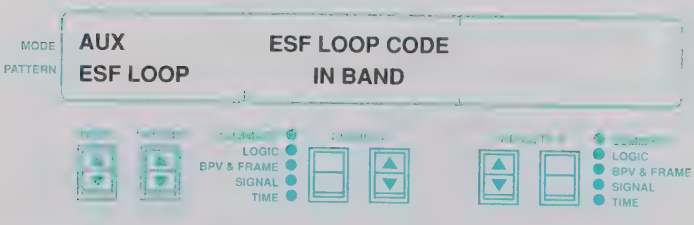
10. **MODE switch**
    Select the AUX mode.

11. **PATTERN switch**

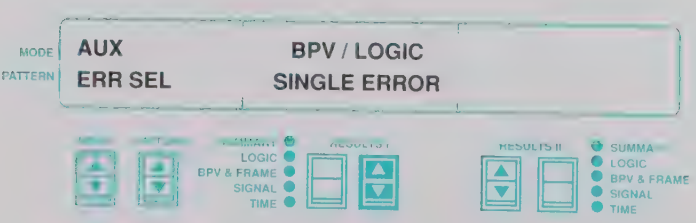
Select AUX LP CODE to set the appropriate loop code.



If testing T1 ESF circuits, select AUX ESF LOOP to set the loop code type.



Select AUX ERR SEL to set the burst duration to insert a single error.



12. MODE switch

Exit the auxiliary function and select the appropriate T1 network framing format.

13. PATTERN switch

Select the appropriate test pattern.

14. LOOP UP switch

Press this switch to send the loop-up code. The switch and Loop Up LED illuminate until the loop code is detected. A loop-up code message appears in the display. The test restarts when the loopback is established.

15. Status LEDs

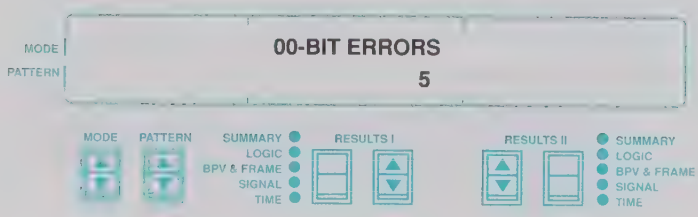
When the loopback is established, these LEDs should illuminate: T1 Pulses, Pattern Sync, Frame Sync, and B8ZS (if applicable).

16. RESULTS I Category switch

Select the SUMMARY category.

17. **LOGIC ERROR INSERT switch**

Press the switch five times to verify that the logic errors are received and the T1 circuit is looped back.



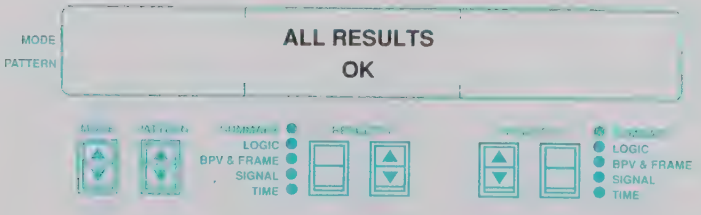
If the loopback is not established, the bit errors do not appear in the display. The failed loopback could be the NIU/CSU not operating correctly, the line from you to the NIU/CSU is bad, or the transmitted loop code is incorrect.

18. **RESTART switch**

Clear the results and start the test.

19. **RESULTS I switches**

Check SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



20. **Results interpretation**

00-BIT ERRORS, 25-VIOLATIONS, 30-FRM ERRORS, and 32-CRC ERRORS (ESF framing only)

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or a faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument.

40-RX FREQ, Hz

The DS1 received frequency should be 1.544 MHz ±75 Hz. If the frequency is out-of-specification, check the transmission equipment timing or the network synchronization.

41-RX LEVEL (dBdsx)

The received level should be +4 to -4 dBdsx at the terminated DSX-1 OUT jacks. Incorrect levels could be caused by a faulty T1 line card or poor cabling between the DSX jack and the equipment.

NOTE: If the Loopback Connector is going to be used as a hard loopback at the MDF, the signal level must be -15 dBdsx or greater to support the loopback signal.

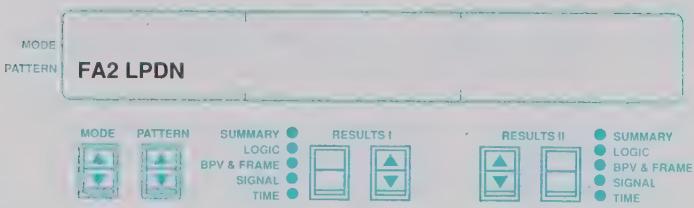
All Ones LED

An Alarm Indication Signal (AIS) indicates that equipment in the signal path is not receiving the T1 signal from the far end. If MULTIPAT or BRIDGTAP is being used, the LED will illuminate when the ALL ONES pattern is transmitted and received.

Disconnect the T-BERD 209A/211

21. **LOOP DOWN switch**

Press this switch to send the loop-down code. The switch and Loop Down LED illuminate until the loopback is released. A loop-down code message appears in the display. Disconnect the T-BERD 209A/211 from the span.



Disconnect the T-BERD Repeater Power Supply

22. **T-BERD Repeater Power Supply AC power**
When you have completed testing the circuit, turn the T-BERD Repeater Power Supply **AC Power** switch OFF.

WARNING: Verify that power has been removed from the T-BERD Repeater Power Supply. Disconnecting the test cords from the T-BERD Repeater Power Supply or the MDF before removing power from the T-BERD Repeater Power Supply creates a 350 VDC potential across the terminals, which can cause personal injury.

23. **Disconnect from the MDF lightning protectors**
When the red High Voltage LED is no longer illuminated, remove the test cords from the distribution frame and replace the lightning protectors.

24. **Disconnect the dual WECO 310 or bantam test cords**
Remove the dual WECO 310 or dual bantam test cords from the T-BERD Repeater Power Supply jacks.

25. **T-BERD 209A/211 AC power**
Remove power from the T-BERD 209A/211.

26. **Disconnect Mainframe Interconnect Cable**
Disconnect the Mainframe Interconnect Cable from the T-BERD 209A/211 15-pin D connector.

19. TESTING FROM MID-SPAN
T-BERD 209A/211 AND T-BERD REPEATER POWER SUPPLY REQUIRED

- Loopback the T1 span line at the MDF and test from mid-span.
- Power a T1 span line from the MDF.

WARNING: It is of the upmost importance that the T-BERD Repeater Power Supply be operated by qualified technicians only in accordance with the safety warnings and instructions contained in this manual and printed on the front panel of the unit. Failure to do so could result in serious personal injury. Carefully read the safety information in Section 4 of the *T-BERD 209A/211 Reference Manual* before operating the T-BERD Repeater Power Supply.

Figure 29 depicts the test setup of the T-BERD Repeater Power Supply at the MDF and the T-BERD 209A/211 at mid-span.

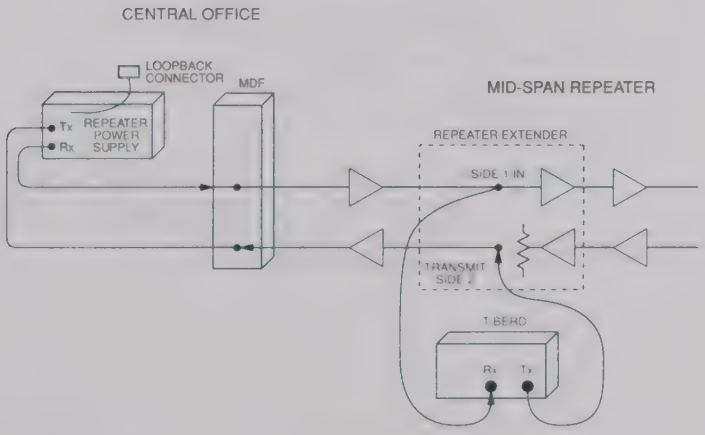


Figure 29
Testing from Mid-Span

Main Distribution Frame Setup

1. **T-BERD Repeater Power Supply test setup**
   Perform Steps 1 through 6 in *Application 16, Testing from the MDF*, to configure the T-BERD Repeater Power Supply at the MDF.

2. **T-BERD 209A/211 test setup**
   Perform Steps 7 through 21 in *Application 16, Testing from the MDF*, to configure the T-BERD 209A/211 and test the span from the MDF.

3. **T-BERD Repeater Power Supply AC Power Switch**
   Turn the AC power OFF.

4. **T-BERD Repeater Power Supply Mainframe Interconnect Cable**
   Disconnect the Mainframe Interconnect Cable from the T-BERD 209A/211 15-pin D connector.

5. **T-BERD Repeater Power Supply Loopback Connector**
   Connect the 15-pin D Loopback Connector to the Mainframe Interconnect Cable.

6. **T-BERD Repeater Power Supply AC Power Switch**
   Coordinate the setup with the mid-span technician before applying AC power. Apply power after the mid-span setup is configured.

   WARNING: Notify the technician at the mid-span point when the span is powered. An unterminated cable pair can have a potential of 350 VDC across it, which can cause personal injury.

Test From Mid-Span

7. **Connecting the T-BERD 209A/211 to the line**
   Connect the T-BERD 209A/211 to the span using the T-BERD Repeater Extender as described in *Application 3, Connecting the T-BERD 209A/211 at Mid-Span.*

8. **Test T1 span**
   With the exception of establishing the loopback with the T-BERD 209A/211, perform one of the loopback applications described in this user's guide to test the span.

Disconnect Test Equipment

9. **T-BERD Repeater Power Supply**
   Remove power from the T-BERD Repeater Power Supply first. When the red High Voltage LED is no longer illuminated, remove the test cords from the distribution frame and replace the lightning protectors.

   WARNING: Verify power has been removed from the T-BERD Repeater Power Supply. Disconnecting the test cords from the T-BERD Repeater Power Supply or the MDF before removing power from the T-BERD Repeater Power Supply creates a 350 VDC potential across the terminals, which can cause personal injury.

10. **T-BERD 209A/211**
    Disconnect the T-BERD 209A/211 from the span.

TESTING DIGITAL LOOP CARRIER (DLC) NETWORKS

MONITORING DLC SHELF OPERATION

TESTING SHELF A RT OPERATION

TESTING RT DATALINK OPERATION

TESTING SHELF B,C,D, OR PROTECT BER PERFORMANCE

VERIFYING RING GENERATION

VERIFYING CHANNEL UNIT SIGNALING

CHECKING DLC MODE 2 TIMESLOT MAPPING

20. MONITORING DLC SHELF OPERATION
T-BERD DLC ANALYZER OPTION REQUIRED

- Perform non-intrusive monitoring of the DLC shelf datalink and DS0 channels.
- Monitor the datalink trafficbetween the Central Office Switch (COS) or Central Office Terminal (COT), and the Remote Terminal (RT) for major, minor, and power/miscellaneous alarms, as well as switch to protect and maintenance tests.
- Monitor DS0 channel signaling in both directions and capture DTMF dialed digits.

Figure 30 illustrates the T-BERD DLC Anlyzer Option monitoring the DLC Shelf A T1 datalink and DS0 channels from the DSX-1 access point.

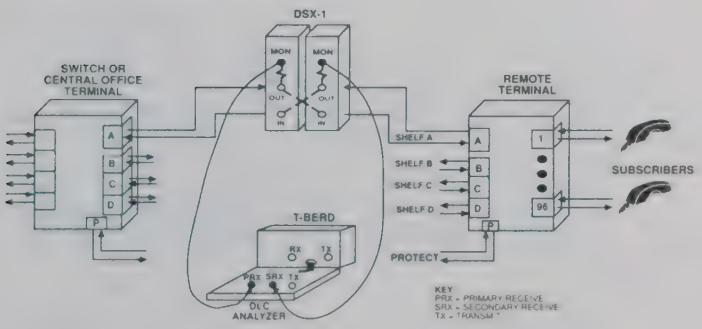


Figure 30
Monitoring DLC Shelf Operation

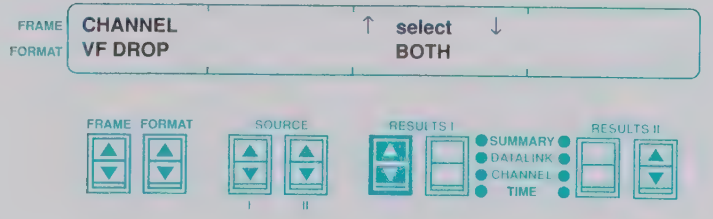
Connect DLC Analyzer Option to T-BERD 209A/211

1. **Apply power to power source**
   If the T-BERD 209A/211 is supplying power, turn power ON. If the external power supply is supplying power, plug external power supply into 110 VAC.

2. **Connect coiled cable**
   Connect the T-BERD DLC Analyzer Option coiled cable to either the T-BERD 209A/211 15-pin D connector or external power supply.

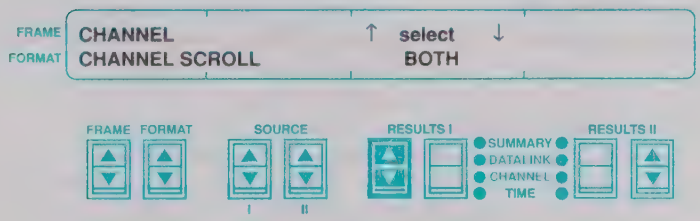
T-BERD DLC Analyzer Option Test Setup

3. **AUX/FRAME/FORMAT switch**
   Select the CHANNEL/VF DROP auxiliary function to set which T1 line the DS0 channel is dropped from.



   Set to PRIMARY to drop the DS0 channel from the PRIMARY RECEIVE T1 signal. Set to SECONDARY to drop the DS0 channel from the SECONDARY RECEIVE T1 signal. Set to BOTH to drop the DS0 channel from both T1 signals.

4. **FORMAT switch**
   Select the CHANNEL/CHANNEL SCROLL auxiliary function to set the **PRIMARY** and **SECONDARY CHANNEL** switch control.



Set to BOTH to scroll the **PRIMARY** and **SECONDARY CHANNEL** switch numbers simul-taneously. Set to SEPARATE to scroll the switch numbers independently.

5. **AUX switch**
   Exit the auxiliary functions.

6. **FRAME switch**
   Select AUTO mode.

7. **CODE switch**
   Select the appropriate coding.

8. **RECEIVE INPUT switch and PRIMARY RECEIVE jack**
   Select the DSX-MON input level and connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.

9. **SECONDARY RECEIVE jack**
   Connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.

10. **RESTART switch**
    Clear the results and start the test.

11. **FRAME/FORMAT window**
    Verify the framing format is detected and recognized.

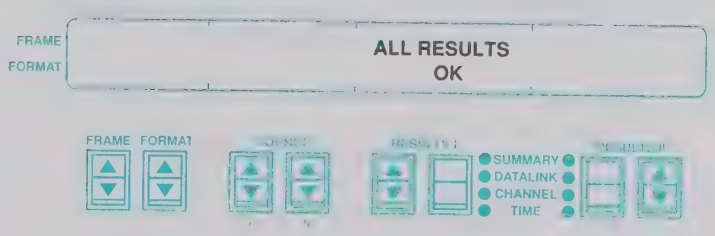
    NOTE: When synchronizing to the SLC-96 framing in AUTO mode, the T-BERD DLC Analyzer Option automatically defaults to the SLC-M1 mode. The SLC-M2 mode must be selected manually with the **FRAME** switch.

12. Status LEDs

These LEDs should illuminate: T1 Pulses, Frame Sync, and B8ZS (if applicable). The Alarm LED may illuminate.

13. RESULTS I switches

Check the SUMMARY category. If errors or alarms are not detected, *ALL RESULTS OK* appears. If errors or alarms are detected, scroll through the SUMMARY category for specific errors or alarms. Check the other categories as required.



14. Datalink results interpretation

Flashing Messages — P/S DATALINK SYNC LOSS

This message occurs when the T-BERD DLC Analyzer Option loses datalink synchronization. This message only appears in the SUMMARY category.

Alarm Messages — P/S FE LOOP PROTECT, P/S FE LOOP SHELF x, P/S MAJOR NO SHELF, P/S MAJOR SHELF x, P/S ALARM SHELF x, P/S MINOR, P/S PWR/MISC, and P/S SHELF x ON PROT

These alarms provide information on the condition of the shelves. These messages also appear in the DATALINK category as a historical record of the indicated events.

Maintenance Test Messages — P/S MAINT HOOK/SEIZE, P/S MAINT PROCEED, and P/S MAINT TEST ALARM

These messages occur when maintenance test messages are detected. These messages also appear in the DATALINK category as a historical record of the indicated events.

15. **T1 signal results interpretation**

P/S SIGNAL LOSS, P/S VIOLATION, P/S FRM ERROR, and P/S CRC ERROR (ESF only)

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument. These messages only appear in the SUMMARY category.

16. **PRIMARY CHANNEL or SECONDARY CHANNEL switch**

Press either switch to select a DS0 channel.

17. **DS0 channel results interpretation**

P/S VF LEVEL, P/S VF FREQ, P/S DATA BITS, and DTMF SEQ

Verify the VF signal level and frequency are within specifications. Verify a data bit is not stuck. Monitor the DTMF dialing sequences. The availability of these results is determined by the CHANNEL/VF DROP auxiliary function.

P/S TRAFFIC CHANNEL AB, P/S TRAFFIC CHANNEL ABCD, P/S TRAFFIC TIMESLOT AB, and P/S TS CHAN

For all framing formats except SLC-M2, monitor the channel signaling bits. For the SLC-M2 framing format, monitor the timeslot signaling and the timeslot channel assignments.

18. **VOLUME control**

Adjust the control to monitor the selected DS0 channel(s) through the speaker. Verify the setting of the CHANNEL/VF DROP auxiliary function.

19. **VF OUT jack**

Connect a TIMS test set to the T-BERD DLC Analyzer Option to perform additional testing and analysis on the selected DS0 channel. Verify the CHANNEL/VF DROP auxiliary function is set to PRIMARY or SECONDARY, not BOTH.

21. TESTING SHELF A RT OPERATION
T-BERD DLC ANALYZER OPTION REQUIRED

- Verify switch to protection line capabilities of Shelf A at the Remote Terminal (RT).
- Verify the far-end loopback capability at the Shelf A RT.

Figures 31 and 32 illustrate the T-BERD DLC Analyzer Option testing the RT from the DSX-1 access point. The numbers in parentheses on the figures are used in the procedure to identify the cables (e.g., connect cable (2)

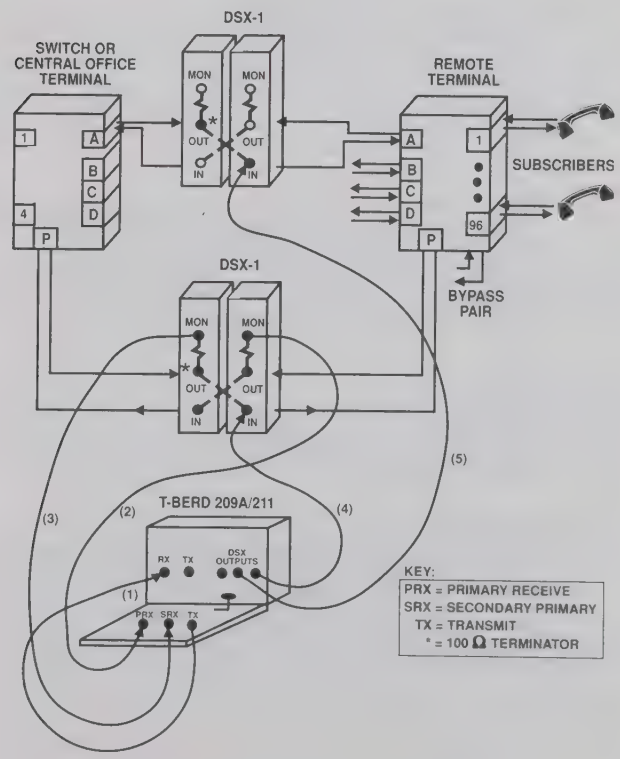


Figure 31
Testing Shelf A RT Operation

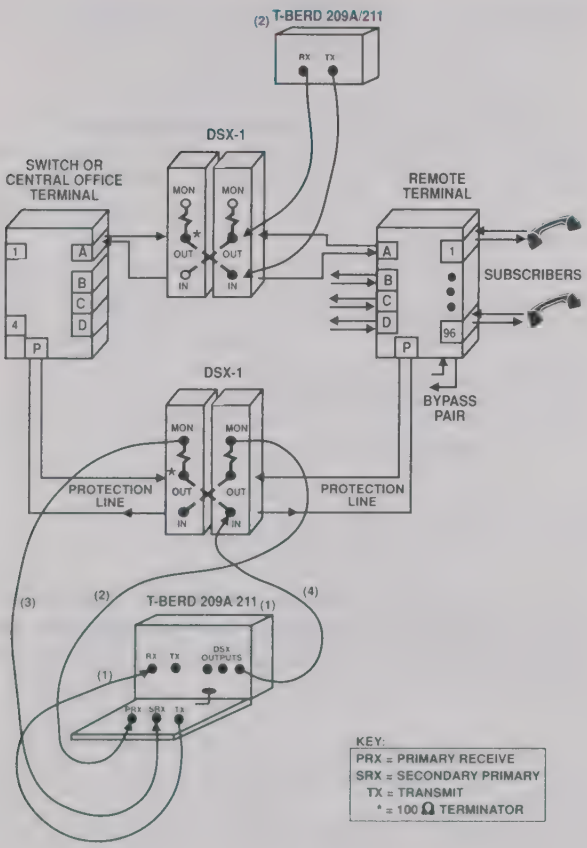


Figure 32
Testing Shelf A RT Operation

Connect DLC Analyzer Option to T-BERD 209A/211

1. **T-BERD 209A/211 — turn power ON**

2. **T-BERD 209A/211 — MODE switch**
   Select T1 TLB mode.

3. **T-BERD 209A/211 — CODE switch**
   Select appropriate coding, AMI or B8ZS, to match the T-BERD DLC Analyzer Option and T1 line coding.

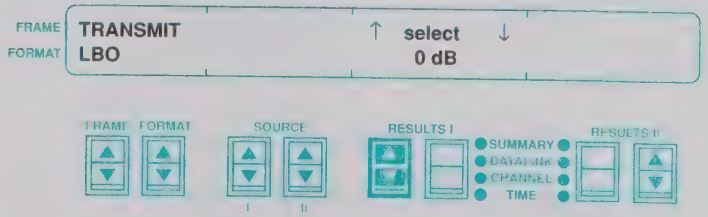
4. **T-BERD 209A/211 — RECEIVE INPUT switch and jack**
   Select the TERM input level and connect cable (1) between this jack and the T-BERD DLC Analyzer Option TRANSMIT jack.

5. **Connect coiled cable**
   Connect the T-BERD DLC Analyzer Option coiled cable to the T-BERD 209A/211 15-pin D connector after applying power to the T-BERD 209A/211.

6. **T-BERD 209A/211 — INSERT switch**
   Verify the switch LED is OFF before connecting the T-BERD DLC Analyzer Option to the circuit.

T-BERD DLC Analyzer Option Test Setup

7. **T-BERD DLC Analyzer Option — AUX/FRAME/FORMAT switch**
   Select TRANSMIT/LBO to set the LBO level. If transmitting into the span, set the LBO for 0.0 dB. If transmitting into the equipment, set the LBO for -15.0 dB.



8. **T-BERD DLC Analyzer Option — AUX switch**
   Exit auxiliary functions.

9. **T-BERD DLC Analyzer Option — FRAME switch**
   Select SLC-M1 or SLC-M2 mode.

10. **T-BERD DLC Analyzer Option — FORMAT switch**
    Select DATLINK format.

11. **T-BERD DLC Analyzer Option — CODE switch**
    Select the appropriate coding.

Connect T-BERD 209A/211/DLC Analyzer Option to the Circuit

12. **T-BERD DLC Analyzer Option — RECEIVE INPUT switch and PRIMARY RECEIVE jack**
    Select the DSX-MON input level. Connect cable (2) to this jack first, then to the T1 protection line as follows:

    If at the CO, connect cable (2) to the T1 protection line span-side DSX-1 MON jack.

    If at the RT, connect cable (2) to the T1 protection line equipment-side DSX-1 MON jack.

13. **T-BERD DLC Analyzer Option — SECONDARY RECEIVE jack**
    Connect cable (3) to this jack first, then to the T1 protection line as follows:

    If at the CO, connect cable (3) to the T1 protection line equipment-side DSX-1 MON jack.

    If at the RT, connect cable (3) to the T1 protection line span-side DSX-1 MON jack.

14. **Protection Line — 100 Ω terminator**
    Plug terminator into one of the following jacks:

    If at the CO, plug into the T1 protection line equipment-side DSX-1 OUT jack.

    If at the RT, plug into the T1 protection line span-side DSX-1 OUT jack.

15. **T-BERD 209A/211 — DSX OUTPUTS jacks**

Cable (4) — Connect cable (4) to the T-BERD 209A/211 first, then to the T1 protection line as follows:

If at the CO, connect cable (4) to the T1 protection line span-side DSX-1 IN jack.

If at the RT, connect cable (4) to the T1 protection line equipment-side DSX-1 IN jack.

NOTE: You may notice a brief glitch in the T1 signal when the cable is connected to the T1 protection line DSX-1 IN jack.

Cable (5) — Connect cable (5) to the T-BERD 209A/211 first, then to Shelf A as follows:

If at the CO, connect cable (5) to the Shelf A span-side DSX-1 IN jack.

If at the RT, connect cable (5) to the Shelf A equipment-side DSX-1 IN jack.

NOTE: Plugging the cable into Shelf A DSX-1 IN jack breaks the T1 line and causes a switch to protect sequence to occur. The switch to protection line messages should appear on the T-BERD DLC Analyzer Option.

16. **Shelf A — 100 Ω terminator**

Plug terminator into one of the following Shelf A jacks:

If at the CO, plug into the Shelf A equipment-side DSX-1 OUT jack.

If at the RT, plug into the Shelf A span-side DSX-1 OUT jack.

17. **T-BERD DLC Analyzer Option — RESTART switch**

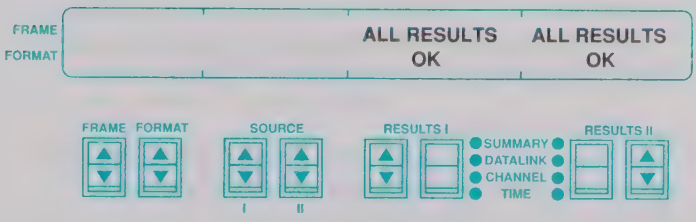
Clear the results and start the test.

18. T-BERD DLC Analyzer Option — Status LEDs

Both primary and secondary LEDs should illuminate: T1 Pulses, Frame Sync, and B8ZS (if applicable). The Alarms LED may illuminate.

19. T-BERD DLC Analyzer Option — RESULTS switches

Check the SUMMARY category. If errors or alarms are not detected, *ALL RESULTS OK* appears. If errors or alarms are detected, scroll through the SUMMARY category for specific errors or alarms. Check the other categories as required.



Verify Far-End Loopback Capability

20. SOURCE I and II switches

Set **SOURCE I** switch to FE LOOP and **SOURCE II** switch to SHELF A.

21. INSERT switch

Press this switch to send the FE LOOP command to the RT. The switch LED illuminates while in the insert mode.

NOTE: When the FE LOOP command is transmitted, it is automatically preceded by a switch to protection line command to prevent an interruption of the selected shelf.

22. **Datalink results interpretation**

P SHELF A ON PROT and SW PROT FAILED

These alarms indicate Shelf A has been switched to the protection line placed in a far-end loopback. These messages also appear in the DATALINK category as a historical record of the indicated events.

WARNING: If the *SW PROT FAILED* message appears, the switch to protection sequence failed, do not continue with the procedure. Disconnect from the circuit in accordance with the Disconnect T-BERD DLC Analyzer Option from the Circuit procedure.

23. **Shelf A — 100 Ω terminator**

Unplug the terminator from DSX-1 OUT jack.

24. **Shelf A — Cable (5)**

Disconnect the cable from the Shelf A DSX-1 IN jack first. Then disconnect the cable from the T-BERD 209A/211.

25. **Connect T-BERD 209A/211 (2) to Shelf A**

Connect a cable from the T-BERD 209A/211 TRANSMIT OUTPUT jack to the DSX-1 IN jack. Connect another cable from the T-BERD 209A/211 RECEIVE INPUT jack to the DSX-1 OUT jack. Configure the T-BERD 209A/211 to perform a loopback test on the shelf and verify the far-end loop is successful.

26. **Disconnect T-BERD 209A/211 (2) from Shelf A**

Disconnect the cables from the DSX-1 patch panel and the T-BERD 209A/211.

27. **T-BERD DLC Analyzer Option — INSERT switch**

Press this switch to stop sending the command to the RT. The switch LED goes out and Shelf A should be released from the far-end loopback.

Disconnect T-BERD DLC Analyzer Option from the Circuit

28. **T-BERD DLC Analyzer Option — INSERT switch**
    Verify the switch LED is OFF before disconnecting the T-BERD DLC Analyzer Option from the circuit.

29. **Protection Line — 100 Ω terminator**
    Unplug the terminator from DSX-1 OUT jack.

30. **Protection Line — Cable (4)**
    Disconnect the cable from the protection line DSX-1 IN jack first. Then disconnect the cable from the T-BERD 209A/211.

31. **PRIMARY RECEIVE and SECONDARY RECEIVE jacks**
    Disconnect the cables from the DSX-1 MON jacks, then the T-BERD DLC Analyzer Option.

32. **Disconnect Cable (1)**
    Disconnect the cable from the T-BERD DLC Analyzer Option TRANSMIT jack and T-BERD 209A/211 RECEIVE INPUT jack.

22. TESTING RT DATALINK OPERATION
T-BERD DLC ANALYZER OPTION REQUIRED

- Verify the major, minor, and power/miscellaneous alarm response capabilities of the remote terminal (RT).
- Verify the switch to protect response capability on Shelves B, C, and D.
- Verify the maintenance test sequence capability on Shelf A.

Figure 33 illustrates the T-BERD DLC Analyzer Option testing the RT from the DSX-1 access point.

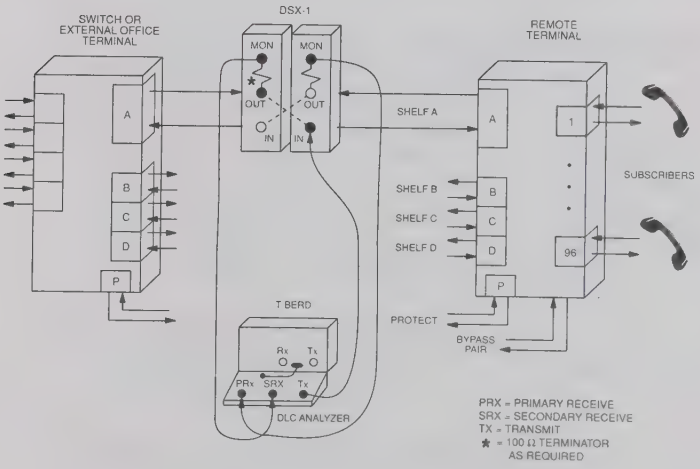


Figure 33
Testing Remote Terminal Datalink Operation

Connect DLC Analyzer Option to T-BERD 209A/211

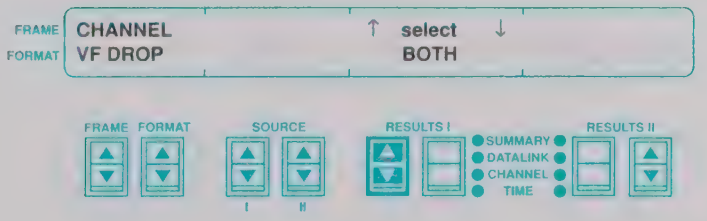
1. **Apply power to power source**
   If the T-BERD 209A/211 is supplying power, turn power ON. If the external power supply is supplying power, plug external power supply into 110 VAC.

2. **Connect coiled cable**
   Connect the T-BERD DLC Analyzer Option coiled cable to either the T-BERD 209A/211 15-pin D connector or external power supply after applying power to the power source.

3. **INSERT switch**
   Verify the switch LED is OFF before connecting the T-BERD DLC Analyzer Option to the circuit.

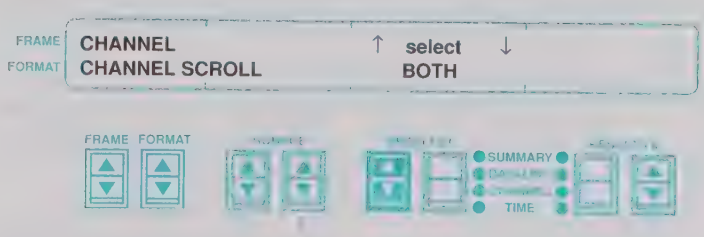
T-BERD DLC Analyzer Option Test Setup

4. **AUX/FRAME/FORMAT switch**
   Select the CHANNEL/VF DROP auxiliary function to select the T1 line the DS0 channel is dropped from.



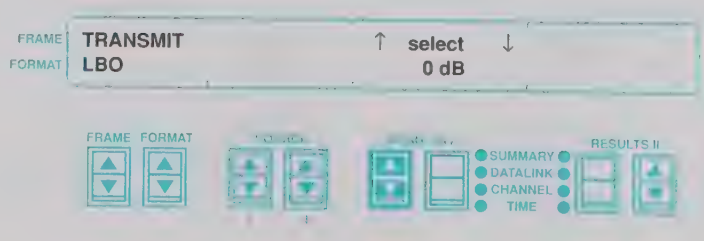
Set to PRIMARY to drop the DS0 channel from the PRIMARY RECEIVE T1 signal. Set to SECONDARY to drop the DS0 channel from the SECONDARY RECEIVE T1 signal. Set to BOTH to drop the DS0 channel from both T1 signals.

5. **FORMAT switch**
   Select the CHANNEL/CHANNEL SCROLL auxiliary function to set the **PRIMARY** and **SECONDARY CHANNEL** switch control.



   Set to BOTH to scroll the **PRIMARY** and **SECONDARY CHANNEL** switch numbers simultaneously. Set to SEPARATE to scroll the switch numbers independently.

6. **FRAME switch**
   Select TRANSMIT/LBO to set the LBO level. If transmitting into the span, set the LBO for 0.0 dB. If transmitting into the equipment, set the LBO for -15.0 dB.



7. **AUX switch**
   Exit auxiliary functions.

8. **FRAME switch**
   Select SLC-M1 mode.

9. **FORMAT switch**
   Select DATLINK format.

10. CODE switch

Select the appropriate coding.

11. RECEIVE INPUT switch and PRIMARY RECEIVE jack

Select the DSX-MON input level. Connect a cable between this jack and the T1 line as follows:

If at the CO, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.

If at the RT, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.

12. SECONDARY RECEIVE jack

Connect a cable between this jack and the T1 line as follows:

If at the CO, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.

If at the RT, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.

13. TRANSMIT jack

Connect the cable to the T-BERD DLC Analyzer Option first, then connect the cable as follows:

If at the CO, connect a cable between this jack and the Shelf A span-side DSX-1 IN jack.

If at the RT, connect a cable between this jack and the Shelf A equipment-side DSX-1 IN jack.

NOTE: You may notice a brief glitch in the T1 signal when the cable is connected to the DSX-1 IN jack. If persistent errors are detected after the cable is connected, verify the resistor isolation at the DSX-1. If improper resistor isolation is determined, plug a 100 Ω terminator into the appropriate DSX-1 OUT jack simultaneously with the cable from the TRANSMIT jack.

14. RESTART switch

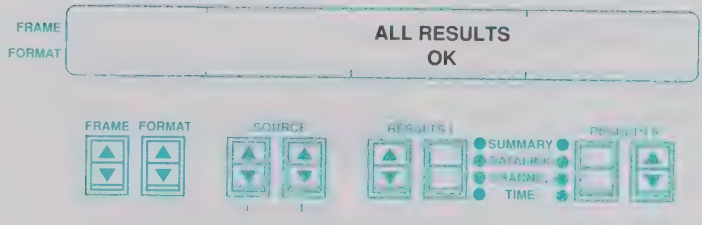
Clear the results and start the test.

15. **Status LEDs**

Both primary and secondary LEDs should illuminate: T1 Pulses, Frame Sync, and B8ZS (if applicable). The Alarms LED may illuminate.

16. **RESULTS I switches**

Check the SUMMARY category. If errors or alarms are not detected, *ALL RESULTS OK* appears. If errors or alarms are detected, scroll through the SUMMARY category for specific errors or alarms. Check the other categories as required.



Testing the Remote Terminal

The following procedures test the RT alarm detection, Shelf B, C, and D switch to protect, and Shelf A maintenance test capabilities.

Verify RT Alarm Detection

1. **SOURCE I and II switches**

Select one of the following alarms and shelves:

SOURCE I MAJOR MINOR PWR/MISC

SOURCE II SHELF A
SHELF B
SHELF C
SHELF D
NO SHELF

2. **INSERT switch**
   Press this switch to insert and send the selected alarm to the RT. The switch LED illuminates while in the insert mode. Repeat Step 1 as required.

3. **Alarm Control Unit (ACU) results interpretation**
   Verify the RT channel bank ACU status LEDs function properly.

4. **Datalink results interpretation**
   P/S DATALINK SYNC LOSS
   If this message appears during testing the Shelf A or C (Mode 2) testing has failed.

5. **INSERT switch**
   Press this switch to stop sending the alarm to the RT. The switch LED goes out.

Verify Switch to Protect Capability

1. **SOURCE I and II switches**
   Select Shelf B, C, or D to test the switch to protect capability. Refer to Application 21 Testing Shelf A Far-end Loop and Switch to Protect Operation to test the switch to protect capability for Shelf A.

   SOURCE I SW PROT

   SOURCE II SHELF B
   SHELF C
   SHELF D

2. **INSERT switch**
   Press this switch to insert and send the selected command to the RT. The switch LED illuminates while in the insert mode.

3. **Datalink results interpretation**

   P/S SHELF x ON PROT and SW PROT FAILED

   These alarms should be indicated at the RT and verified with the T-BERD DLC Analyzer Option. These messages also appear in the DATALINK category as a historical record of the indicated events. If the *SW PROT FAILED* message appears, the selected shelf failed the switch to protection sequence.

4. **INSERT switch**

   Press this switch to stop sending the command to the RT. The switch LED goes out.

Verify Mode I Maintenance Test Sequence

NOTE: The following procedure can only be performed on Shelf A.

1. **SOURCE I switch**

   Select the MAINT command to establish the automated maintenance test procedure.

2. **SECONDARY CHANNEL switch**

   Select the desired DS0 channel from 1 to 24 only.

3. **INSERT switch**

   Press this switch to insert and send the MAINT command to the RT. The switch LED illuminates while in the insert mode. The maintenance test is performed with the DS0 channel selected in Step 2.

4. **Verify transmitted maintenance test sequence**

   Monitor the SOURCE II line during the test to verify the proper sequence is performed. The T-BERD DLC Analyzer Option displays the following *lowercase* messages when waiting for message responses from the RT and *uppercase* messages when reporting on the status of the messages transmitted from the RT:

   - When the *hook/seize* message appears, the T-BERD DLC Analyzer Option is waiting for the RT to respond with the *P HOOK/SEIZE* message.

- When the *proceed* message appears, the T-BERD DLC Analyzer Option is waiting for the RT to respond with the *P PROCEED* message.

- When the *succeed* message appears, the maintenance test sequence is successful and the *P HOOK/SEIZE* and *P PROCEED* appear.

- If the *abort* message appears and the RT only responds with a *P TEST ALARM* message, RT may not have been able to seize the bypass pair.

- If the *abort* message appears and the RT responds with either the *P HOOK/SEIZE* or *PROCEED* message, an indeterminate problem occurred.

- If the *test alarm* message appears and the RT does not respond within the required time, either the subscriber channel unit or the CTU may not be responding to the maintenance test sequence.

- If the *test alarm* message appears and the RT only responds with the *P HOOK/SEIZE* message, the CTU may not be responding to the maintenance test sequence.

NOTE: The T-BERD DLC Analyzer Option emulates the maintenance test generated from the COT.

5. **INSERT switch**

Press this switch to stop sending the command to the RT. The switch LED goes out.

Disconnect the T-BERD DLC Analyzer Option

1. **INSERT switch**
   Verify the switch LED is OFF before disconnecting the T-BERD DLC Analyzer Option from the circuit.

2. **TRANSMIT jack**
   Disconnect the cable from the DSX-1 jack first. Then disconnect the cable from the T-BERD DLC Analyzer Option. If the 100 Ω terminator is used, unplug the terminator from the DSX-1 OUT jack and DSX-1 IN jack cable simultaneously.

   NOTE: You may notice a brief glitch in the T1 signal when the cable is disconnected from the DSX-1 IN jack.

3. **PRIMARY RECEIVE and SECONDARY RECEIVE jacks**
   Disconnect the cables from the DSX-1 MON jacks, then the T-BERD DLC Analyzer Option.

23. TESTING SHELF B, C, D, OR PROTECT BER PERFORMANCE

T-BERD DLC ANALYZER OPTION REQUIRED

- Verify the bit error rate performance, switch to protection, and far-end loop response capabilities of Shelf B, C, D, or PROTECT at the RT.

Figure 34 illustrates the T-BERD DLC Analyzer Option and T-BERD 209A/211 testing the RT from the CO DSX-1 access point.

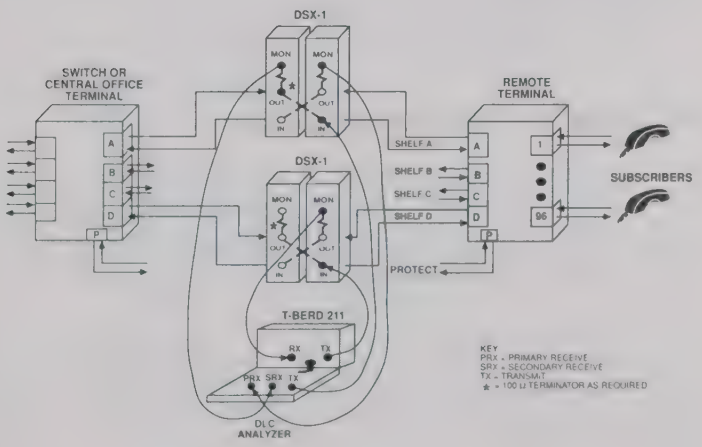


Figure 34
Testing Shelf B, C, D, or Protect BER Performance

Connect DLC Analyzer Option to the T-BERD 209A/211

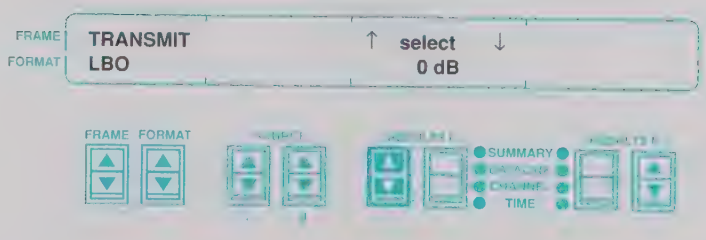
1. **Apply power to power source**
   If the T-BERD 209A/211 is supplying power, turn power ON. If the external power supply is supplying power, plug external power supply into 110 VAC.

2. **Connect coiled cable**
   Connect the T-BERD DLC Analyzer Option coiled cable to either the T-BERD 209A/211 15-pin D connector or external power supply after applying power to the power source.

3. **INSERT switch**
   Verify the switch LED is OFF before connecting the T-BERD DLC Analyzer Option to the circuit.

T-BERD DLC Analyzer Option Test Setup

4. **AUX/FRAME/FORMAT switch**
   Select TRANSMIT/LBO to set the LBO level. If transmitting into the span, set the LBO for 0.0 dB. If transmitting into the equipment, set the LBO for -15.0 dB.



5. **AUX switch**
   Exit auxiliary functions.

6. **FRAME switch**
   Select SLC-M1 or SLC-M2 mode.

NOTE: Do not attempt to perform a far-end loop on Shelf B or D of a Mode 2 DLC system.

7. FORMAT switch

Select DATLINK format.

8. CODE switch

Select the appropriate coding.

9. RECEIVE INPUT switch and PRIMARY RECEIVE jack

Select the DSX-MON input level. Connect a cable between this jack and the T1 line as follows:

If at the CO, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.

If at the RT, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.

10. SECONDARY RECEIVE jack

Connect a cable between this jack and the T1 line as follows:

If at the CO, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.

If at the RT, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.

11. TRANSMIT jack

Connect the cable to the T-BERD DLC Analyzer Option first, then connect the cable as follows:

If at the CO, connect a cable between this jack and the Shelf A span-side DSX-1 IN jack.

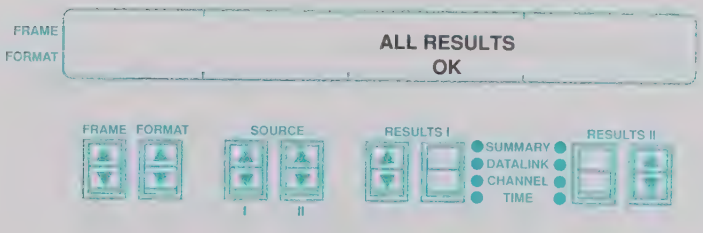
If at the RT, connect a cable between this jack and the Shelf A equipment-side DSX-1 IN jack.

NOTE: You may notice a brief glitch in the T1 signal when the cable is connected to the DSX-1 IN jack. If persistent errors are detected after the cable is connected, verify the resistor isolation at the DSX-1. If improper resistor isolation is determined, plug a 100 Ω terminator into the appropriate DSX-1 OUT jack simultaneously with the cable from the TRANSMIT jack.

12. **RESTART switch**
    Clear the results and start the test.

13. **Status LEDs**
    Both primary and secondary LEDs should illuminate: T1 Pulses, Frame Sync, and B8ZS (if applicable). The Alarms LED may illuminate.

14. **RESULTS I switches**
    Check the SUMMARY category. If errors or alarms are not detected, *ALL RESULTS OK* appears. If errors or alarms are detected, scroll through the SUMMARY category for specific errors or alarms. Check the other categories as required.



15. **SOURCE I and II switches**
    Select **SOURCE I** for FE LOOP and **SOURCE II** for either SHELF B, C, D or PROTECT.

16. **INSERT switch**
    Press this switch to insert and send the far-end loop command to the RT. The switch LED illuminates while in the insert mode. SHELF B, C, or D is automatically switched to the protection line and the SHELF B, C, D or PROTECT T1 line is looped back.

    NOTE: When the far-end loopback command is transmitted, the command is automatically preceded by a switch to protection line command to prevent an interruption of the selected shelf.

17. **Datalink results interpretation**

P SHELF D ON PROT and P FE LOOP SHELF D

These alarms indicate SHELF B, C, or D is switched to the protection line and looped back to the CO.

WARNING: If the *SW PROT FAILED* message appears, the switch to protection sequence failed, do not continue with the procedure.

T-BERD 209A/211 Mainframe Test Setup

1. **MODE switch**

Select the T1 D4 or T1 ESF mode.

2. **PATTERN switch**

Select the appropriate test pattern, e.g., T1-QRSS.

3. **TIMING switch**

Set to INT.

4. **RECEIVE INPUT switch and jack**

Select the DSX-MON input level. Connect a cable between this jack and the T1 line as follows:

If at the CO, connect a cable between this jack and the Shelf B, C, D, or PROTECT span-side DSX-1 OUT jack.

If at the RT, connect a cable between this jack and the Shelf B, C, D, or PROTECT equipment-side DSX-1 OUT jack.

5. **TRANSMIT OUTPUT switch and jack**

Select the appropriate output level, and connect a cable between this jack and the T1 line as follows:

If at the CO, set the output level to 0dB(DSX) and connect a cable between this jack and the Shelf B, C, D, or PROTECT span-side DSX-1 IN jack.

If at the RT, set the output level to -15dB and connect a cable between this jack and the Shelf B, C, D, or PROTECT equipment-side DSX-1 IN jack.

6. **Status LEDs**

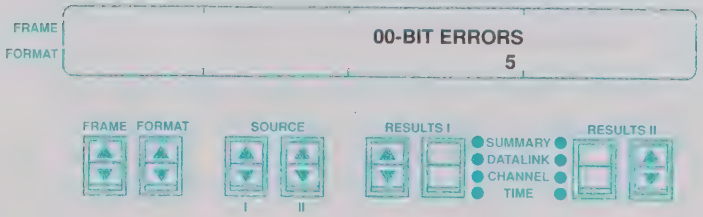
   These LEDs should illuminate: T1 Pulses, Pattern Sync, Frame Sync, and B8ZS (if applicable).

7. **RESULTS I Category switch**

   Select the SUMMARY category.

8. **LOGIC ERROR INSERT switch**

   Press the switch five times to verify the logic errors are received and the T1 circuit is looped back.

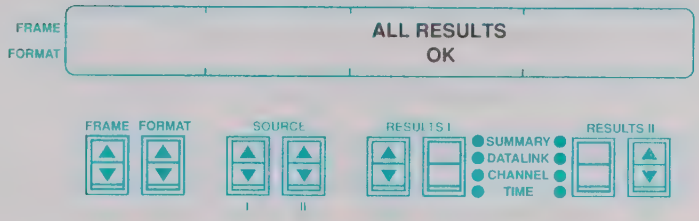


9. **RESTART switch**

   Clear the results and start the test.

10. **RESULTS I switches**

    Check the SUMMARY category. If errors are not detected, *ALL RESULTS OK* appears. If errors are detected, scroll through the SUMMARY category for specific errors. Check the other categories as required.



11. Results interpretation

00-BIT ERRORS, 25-VIOLATIONS, and 30-FRM ERRORS

These errors typically indicate a local T1 span problem caused by a faulty repeater, span line noise, crosstalk, poor cabling, defective DSX jacks, or faulty multiplexer. Electrical noise, generated near the metallic span can also contribute to errors received at the instrument.

40-RX FREQ, Hz

The DS1 received frequency should be 1.544 MHz ±75 Hz. If the frequency is out-of-specification, check the transmission equipment timing or the network synchronization.

41-RX LEVEL (dBdsx)

The received level should be +4 to -4 dBdsx at the terminated DSX-1 OUT jacks. Incorrect levels could be caused by a faulty T1 line card or poor cabling between the DSX jack and the equipment.

Yellow Alarm LED

The far end sends a Yellow Alarm to indicate it is not receiving a T1 signal.

All Ones LED

An Alarm Indication Signal (AIS) indicates equipment in the signal path is not receiving the T1 signal from the far end.

Disconnect the Test Sets

1. **T-BERD 209A/211 — Disconnect the cables**
   When the test is complete, disconnect the cables from the SHELF B, C, D, or PROTECT DSX-1 jacks.

2. **T-BERD DLC Analyzer Option — INSERT switch**
   Press this switch to release SHELF B, C, D, or PROTECT from the far-end loopback and protection line. Verify the switch LED extinguishes.

3. **T-BERD DLC Analyzer Option — TRANSMIT jack**
   Disconnect the cable from the DSX-1 jack first. Then disconnect the cable from the T-BERD DLC Analyzer Option. If the 100 Ω terminator is used, unplug the terminator from the DSX-1 OUT jack and DSX-1 IN jack cable simultaneously.

   NOTE: You may notice a brief glitch in the T1 signal when the cable is disconnected from the DSX-1 IN jack.

4. **PRIMARY RECEIVE and SECONDARY RECEIVE jacks**
   Disconnect the cables from the DSX-1 MON jacks, then the T-BERD DLC Analyzer Option.

24. VERIFYING RING GENERATION
T-BERD DLC ANALYZER OPTION REQUIRED

- Verify the ring generator is functioning properly at the RT.

Figure 35 illustrates the T-BERD DLC Analyzer Option testing the RT ring generator from the DSX-1 access point.

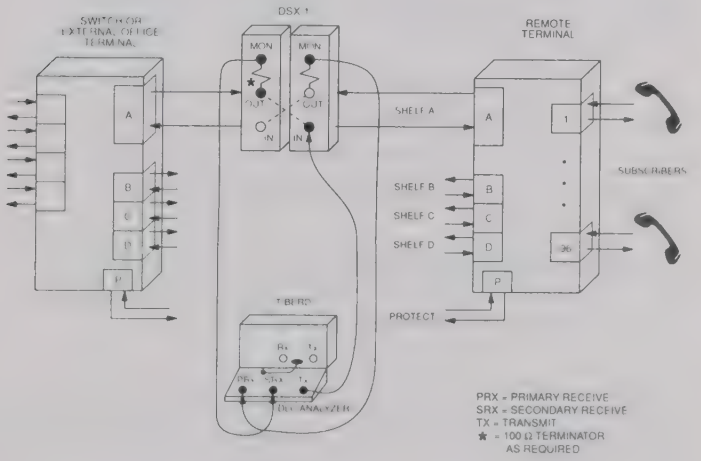


Figure 35
Testing Ring Generators

Connect DLC Analyzer Option to T-BERD 209A/211

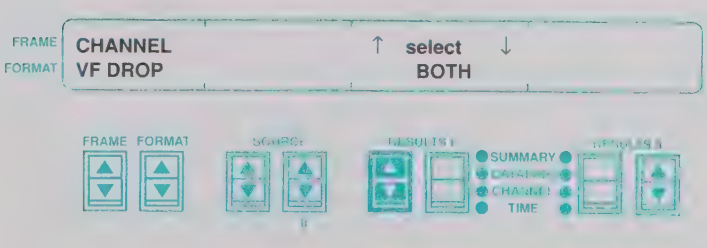
1. **Apply power to power source**
   If the T-BERD 209A/211 is supplying power, turn power ON. If the external power supply is supplying power, plug external power supply into 110 VAC.

2. **Connect coiled cable**
   Connect the T-BERD DLC Analyzer Option coiled cable to either the T-BERD 209A/211 15-pin D connector or external power supply after applying power to the power source.

3. **INSERT switch**
   Verify the switch LED is OFF before connecting the T-BERD DLC Analyzer Option to the circuit.

T-BERD DLC Analyzer Option Test Setup

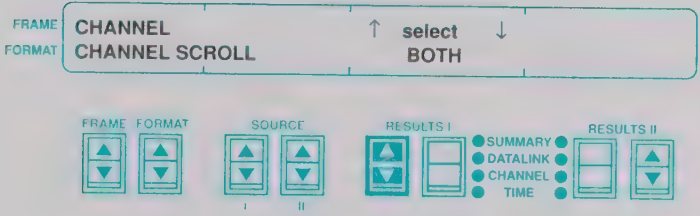
4. **AUX/FRAME/FORMAT switch**
   Select the CHANNEL/VF DROP auxiliary function to select the T1 line the DS0 channel is dropped from.



Set to PRIMARY to drop the DS0 channel from the PRIMARY RECEIVE T1 signal. Set to SECONDARY to drop the DS0 channel from the SECONDARY RECEIVE T1 signal. Set to BOTH to drop the DS0 channel from both T1 signals.

5. FORMAT switch

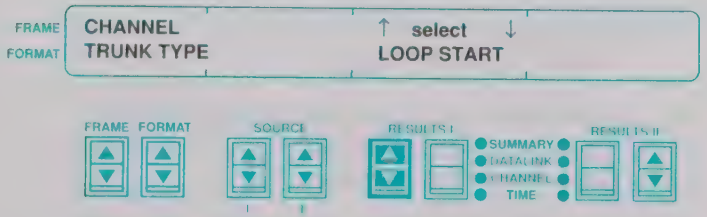
Select the CHANNEL/CHANNEL SCROLL auxiliary function to set the **PRIMARY** and **SECONDARY CHANNEL** switch control.



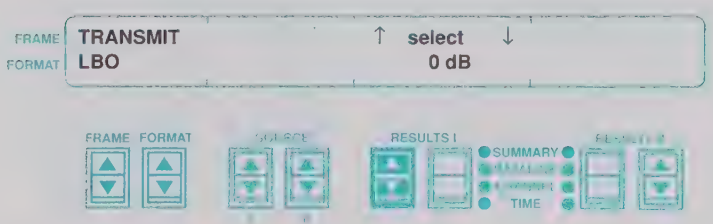
Set to BOTH to scroll the **PRIMARY** and **SECONDARY CHANNEL** switch numbers simultaneously. Set to SEPARATE to scroll the switch numbers independently.

6. FORMAT switch

Select the CHANNEL/TRUNK TYPE auxiliary function to set the signaling protocol.



7. **FRAME switch**
   Select TRANSMIT/LBO to set the LBO level. If transmitting into the span, set the LBO for 0.0 dB. If transmitting into the equipment, set the LBO for -15.0 dB.



8. **AUX switch**
   Exit auxiliary functions.

9. **FRAME switch**
   Select SLC-M1 mode.

10. **FORMAT switch**
    Select CHANNEL format.

11. **CODE switch**
    Select the appropriate coding.

12. **RECEIVE INPUT switch and PRIMARY RECEIVE jack**
    Select the DSX-MON input level. Connect a cable between this jack and the T1 line as follows:

    If at the CO, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.

    If at the RT, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.

26. CHECKING SLC MODE 2 TIMESLOT MAPPING
T-BERD DLC ANALYZER OPTION REQUIRED

- Verify the Mode 2 timeslot channel mapping.

Figure 37 illustrates the T-BERD DLC Analyzer Option testing the Mode 2 RT from the CO DSX-1 access point.

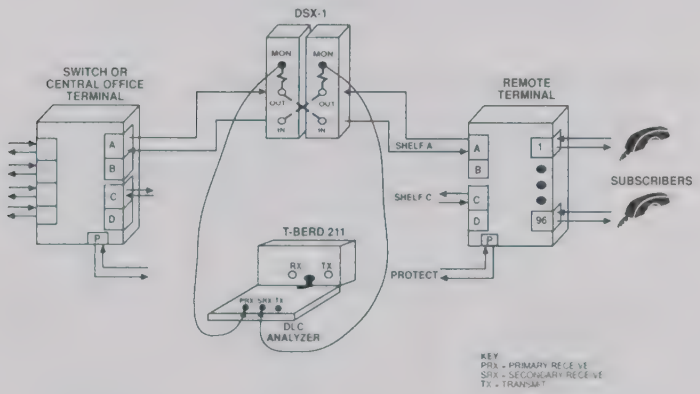
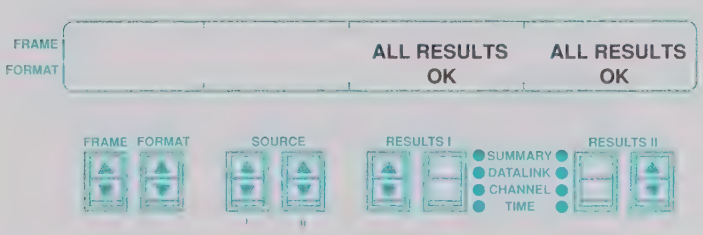


Figure 37
Checking SLC Mode 2 Timeslot Mapping

17. **RESULTS switches**

Check the SUMMARY category. If errors or alarms are not detected, *ALL RESULTS OK* appears. If errors or alarms are detected, scroll through the SUMMARY category for specific errors or alarms. Check the other categories as required.



Select one of the following CHANNEL category test results to monitor the channel signaling: P TRAFFIC CHANNEL AB, P TRAFFIC CHANNEL ABCD, P TRAFFIC TIMESLOT, or P TS CHAN.

18. **SECONDARY CHANNEL switch**

Select the desired DS0 channel.

19. **INSERT switch**

Press this switch to insert the ringing signal. The switch LED illuminates.

20. **RING switch**

Press this switch to ring the local subscriber loop. Note the ring back signal is heard from the speaker. The switch LED illuminates while active and the **ABCD** switches are updated.

NOTE: The T-BERD DLC Analyzer Option emulates the central office terminal.

21. **DS0 channel results interpretation**

P/S TRAFFIC CHANNEL AB, P TRAFFIC TIMESLOT, and P TS CHAN

Monitor the channel signaling bits in both directions. If SLC-M2 framing is used, valid timeslot signaling can only be monitored from the CO.

Disconnect the T-BERD DLC Analyzer Option

22. **TRANSMIT jack**

    Disconnect the cable from the DSX-1 jack first. Then disconnect the cable from the T-BERD DLC Analyzer Option. If the 100 Ω terminator is used, unplug the terminator from the DSX-1 OUT jack and DSX-1 IN jack cable simultaneously.

    NOTE: You may notice a brief glitch in the T1 signal when the cable is disconnected from the DSX-1 IN jack.

23. **PRIMARY RECEIVE and SECONDARY RECEIVE jacks**

    Disconnect the cables from the DSX-1 MON jacks, then the T-BERD DLC Analyzer Option.

25. VERIFYING CHANNEL UNIT SIGNALING
T-BERD DLC ANALYZER OPTION REQUIRED

- Test on-hook, off-hook, and dialing signaling on one or all 24 channels on a shelf.

Figure 36 illustrates the T-BERD DLC Analyzer Option testing the DTMF dialing capabilities from the DSX-1 access point.

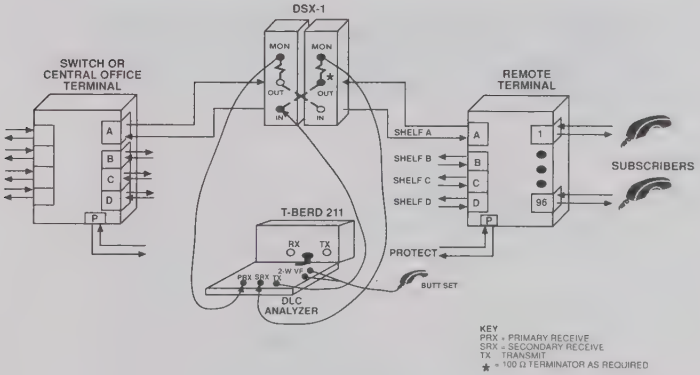


Figure 36
Verifying Channel Unit Signaling

Connect DLC Analyzer Option to the T-BERD 209A/211

1. **Apply power to power source**
   If the T-BERD 209A/211 is supplying power, turn power ON. If the external power supply is supplying power, plug external power supply into 110 VAC.

2. **Connect coiled cable**
   Connect the T-BERD DLC Analyzer Option coiled cable to either the T-BERD 209A/211 15-pin D connector or external power supply after applying power to the power source.

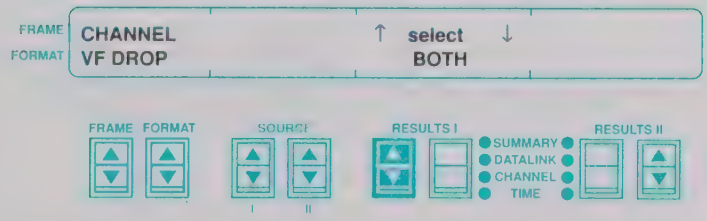
3. **INSERT switch**

Verify the switch LED is OFF before connecting the T-BERD DLC Analyzer Option to the circuit.

T-BERD DLC Analyzer Option Test Setup

4. **AUX/FRAME/FORMAT switch**

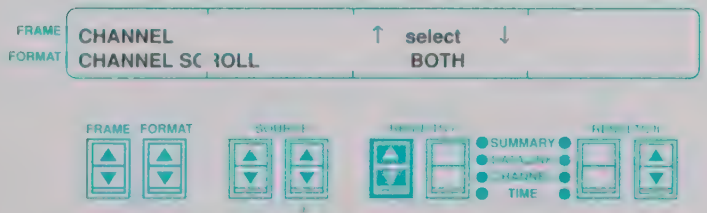
Select the CHANNEL/VF DROP auxiliary function to select the T1 line the DS0 channel is dropped from.



Set to PRIMARY to drop the DS0 channel from the PRIMARY RECEIVE T1 signal. Set to SECONDARY to drop the DS0 channel from the SECONDARY RECEIVE T1 signal. Set to BOTH to drop the DS0 channel from both T1 signals.

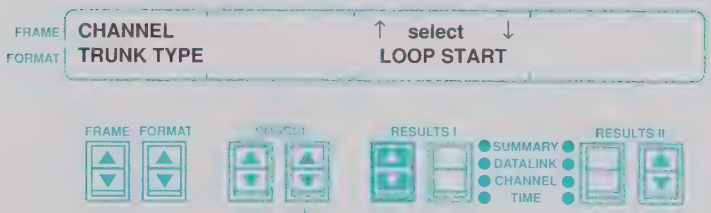
5. **FORMAT switch**

Select the CHANNEL/CHANNEL SCROLL auxiliary function to set the **PRIMARY** and **SECONDARY CHANNEL** switch control.

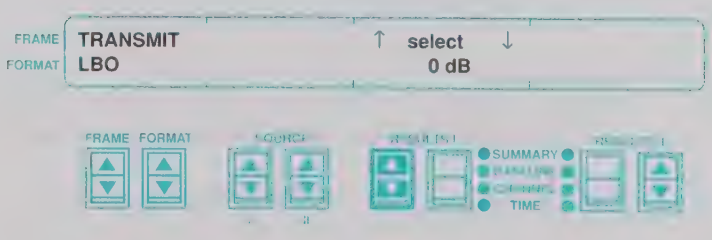


Set to BOTH to scroll the **PRIMARY** and **SECONDARY CHANNEL** switch numbers simultaneously. Set to SEPARATE to scroll the switch numbers independently.

6. **FORMAT switch**
   Select the CHANNEL/TRUNK TYPE auxiliary function to set the signaling protocol.



7. **FRAME switch**
   Select TRANSMIT/LBO to set the LBO level. If transmitting into the span, set the LBO for 0.0 dB. If transmitting into the equipment, set the LBO for -15.0 dB.



8. **AUX switch**
   Exit auxiliary functions.

9. **FRAME switch**
   Select SLC-M1 mode.

10. **FORMAT switch**
    Select CHANNEL format.

11. **CODE switch**
    Select the appropriate coding.

12. **2-Wire VF Interface**
    Connect a butt-set to the 2-wire VF posts on the right side near the RS-232 interface. Leave the butt-set **MON/TALK** switch in the MON or released position.

13. **RECEIVE INPUT switch and PRIMARY RECEIVE jack**
    Select the DSX-MON input level. Connect a cable between this jack and the T1 line as follows:

    If at the CO, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.

    If at the RT, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.

14. **SECONDARY RECEIVE jack**
    Connect a cable between this jack and the T1 line as follows:

    If at the CO, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.

    If at the RT, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.

15. **TRANSMIT jack**
    Connect the cable to the T-BERD DLC Analyzer Option first, then connect the cable as follows:

    If at the CO, connect a cable between this jack and the Shelf A equipment-side DSX-1 IN jack.

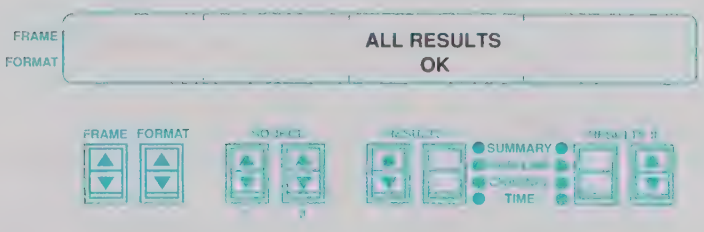
If at the RT, connect a cable between this jack and the Shelf A span-side DSX-1 IN jack.

NOTE: You may notice a brief glitch in the T1 signal when the cable is connected to the DSX-1 IN jack. If persistent errors are detected after the cable is connected, verify the resistor isolation at the DSX-1. If improper resistor isolation is determined, plug a 100 Ω terminator into the appropriate DSX-1 OUT jack simultaneously with the cable from the TRANSMIT jack.

16. **RESTART switch**
    Clear the results and start the test.

17. **Status LEDs**
    Both primary and secondary LEDs should illuminate: T1 Pulses, Frame Sync, and B8ZS (if applicable). The Alarms LED may illuminate.

18. **RESULTS I switches**
    Check the SUMMARY category. If errors or alarms are not detected, *ALL RESULTS OK* appears. If errors or alarms are detected, scroll through the SUMMARY category for specific errors or alarms. Check the other categories as required.



Select one of the following CHANNEL category test results to monitor the channel signaling: P/S TRAFFIC CHANNEL AB, P/S TRAFFIC CHANNEL ABCD, P/S TRAFFIC TIMESLOT, or P/S TS CHAN.

19. **SOURCE I switch**
Set to VF INTF.

20. **SECONDARY CHANNEL switch**
Select the desired DS0 channel.

21. **INSERT switch**
Press this switch to test from the 2-wire VF interface. The switch LED illuminates while in the insert mode.

22. **VOLUME control**
Adjust the control to monitor the selected DS0 channel through the speaker. Verify the line is idle.

23. **OFF HOOK switch**
Press this switch to place the channel off hook. Note that the dial tone can be heard from the speaker. The switch LED illuminates while active and the **ABCD** switches are updated. The **ON HOOK** switch LED goes out and the **ABCD** switches indicate the change.

NOTE: If the dial tone is not heard, verify the trunk type signaling protocol is properly set by the CHANNEL/TRUNK TYPE auxiliary function. Also check the volume level of the speaker.

24. **Butt-set**
Press the **MON/TALK** switch to the TALK position. Verify dial tone is heard.

Dial the telephone number. Verify ringing is heard and the telephone is answered.

Press the **MON/TALK** switch to the MON position.

25. **ON HOOK switch**
Press this switch to place the channel on hook. The switch LED illuminates while active and the **ABCD** switches are updated. Verify the line is idle and dial tone is not heard from the butt-set.

26. **DS0 channel results interpretation**
P/S TRAFFIC CHANNEL AB, P TRAFFIC TIMESLOT, and P TS CHAN
Monitor the channel signaling bits in both directions. If SLC-M2 framing is used, valid timeslot signaling can only be monitored from the CO.

Disconnect the T-BERD DLC Analyzer Option

27. **TRANSMIT jack**
Disconnect the cable from the DSX-1 jack first. Then disconnect the cable from the T-BERD DLC Analyzer Option. If the 100 Ω terminator is used, unplug the terminator from the DSX-1 OUT jack and DSX-1 IN jack cable simultaneously.

NOTE: You may notice a brief glitch in the T1 signal when the cable is disconnected from the DSX-1 IN jack.

28. **PRIMARY RECEIVE and SECONDARY RECEIVE jacks**
Disconnect the cables from the DSX-1 MON jacks, then the T-BERD DLC Analyzer Option.

29. **Butt-set**
Disconnect from the 2-wire VF posts.

26. CHECKING SLC MODE 2 TIMESLOT MAPPING
T-BERD DLC ANALYZER OPTION REQUIRED

- Verify the Mode 2 timeslot channel mapping.

Figure 37 illustrates the T-BERD DLC Analyzer Option testing the Mode 2 RT from the CO DSX-1 access point.

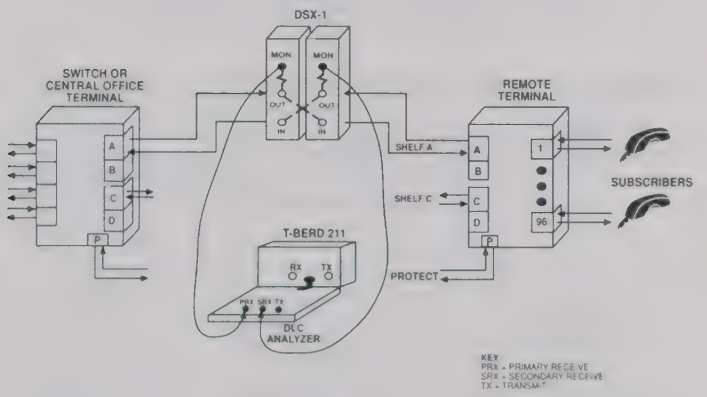


Figure 37
Checking SLC Mode 2 Timeslot Mapping

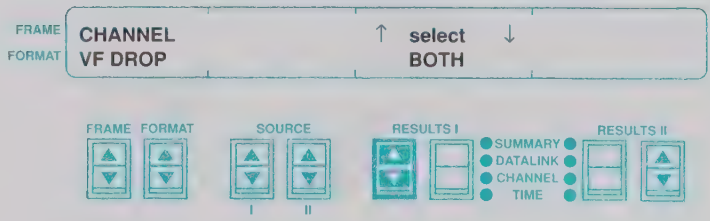
Connect DLC Analyzer Option to the T-BERD 209A/211

1. **Apply power to power source**
   If the T-BERD 209A/211 is supplying power, turn power ON. If the external power supply is supplying power, plug external power supply into 110 VAC.

2. **Connect coiled cable**
   Connect the T-BERD DLC Analyzer Option coiled cable to either the T-BERD 209A/211 15-pin D connector or external power supply after applying power to the power source.

T-BERD DLC Analyzer Option Test Setup

3. **AUX/FRAME/FORMAT switch**
   Select the CHANNEL/VF DROP auxiliary function to set which T1 line the DS0 channel is dropped from.



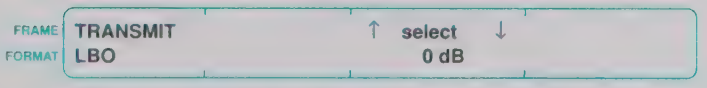
   Set to PRIMARY to drop the DS0 channel from the PRIMARY RECEIVE T1 signal. Set to SECONDARY to drop the DS0 channel from the SECONDARY RECEIVE T1 signal. Set to BOTH to drop the DS0 channel from both T1 signals.

4. **FORMAT switch**
   Select the CHANNEL/CHANNEL SCROLL auxiliary function to set the **PRIMARY** and **SECONDARY CHANNEL** switch control.

Set to BOTH to scroll the **PRIMARY** and **SECONDARY CHANNEL** switch numbers simultaneously. Set to SEPARATE to scroll the switch numbers independently.

5. **FRAME switch**

   Select TRANSMIT/LBO to set the LBO level. If transmitting into the span, set the LBO for 0.0 dB. If transmitting into the equipment, set the LBO for -15.0 dB.



6. **AUX switch**

   Exit auxiliary functions.

7. **FRAME switch**

   Select SLC-M2 mode.

8. **CODE switch**

   Select the appropriate coding.

9. **RECEIVE INPUT switch and PRIMARY RECEIVE jack**
   Select the DSX-MON input level. Connect a cable between this jack and the T1 line as follows:

   If at the CO, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.

   If at the RT, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.

10. **SECONDARY RECEIVE jack**
    Connect a cable between this jack and the T1 line as follows:

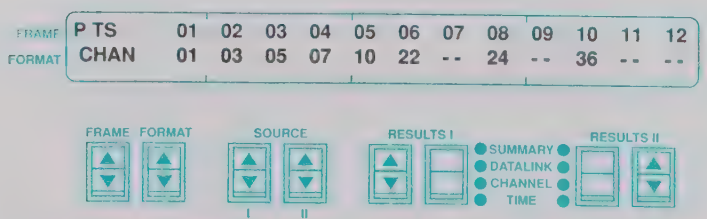
    If at the CO, connect a cable between this jack and the Shelf A span-side DSX-1 MON jack.

    If at the RT, connect a cable between this jack and the Shelf A equipment-side DSX-1 MON jack.

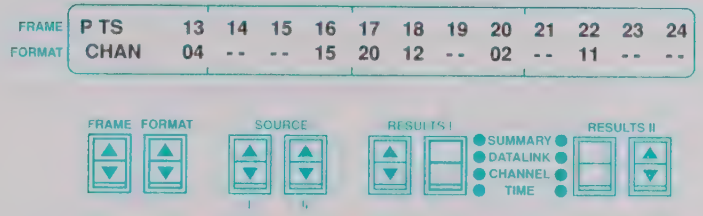
11. **RESTART switch**
    Clear the results and start the test.

12. **Status LEDs**
    The following primary and secondary LEDs should illuminate: T1 Pulses, Frame Sync, and B8ZS (if applicable). The Alarms LED may illuminate.

13. **RESULTS I switches**
    Select the CHANNEL category P TS CHAN result. Determine which timeslot or channel you want to monitor. The timeslots are indicated across the top line. The active timeslots have the mapped channel number below it. The "— —" indicates an unassigned timeslot.



Press the **RESULTS I Results** switch to scroll to timeslots 13 to 24.



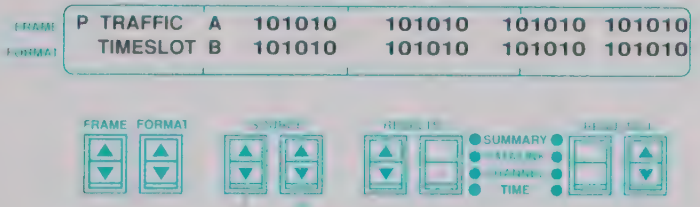
NOTE: Only valid timeslot channel assignments can be monitored from the CO.

14. PRIMARY CHANNEL switch

Select the channel you want to monitor by displaying the *timeslot* number in the channel display. For example, to monitor channel 04 above, press the **PRIMARY CHANNEL** switch to display timeslot 13, monitor channel 15 by displaying timeslot 16.

15. RESULTS I Results switch

Select the CHANNEL category P/S TRAFFIC TIMESLOT AB result to monitor the timeslot signaling bits.



16. **SLC-M2 channel results interpretation**

P TS CHAN

The top row of numbers indicate the available timeslots. The bottom row of numbers identify the assigned channel of an active timeslot. An unassigned timeslot is indicated by two dashes (— —). An unknown timeslot assignment is left blank. The result is automatically updated as channels assignments and traffic change. Press the **RESULTS I Results** switch to display the PRIMARY (P) timeslot channel assignments.

P/S TRAFFIC TIMESLOT AB

This result displays the A and B signaling bits in all 24 timeslots from a single receiver input. Press the **RESULTS I Results** switch to display either the PRIMARY (P) or SECONDARY (S) signaling traffic.

NOTE: The **ABCD** switches are functional in all frame modes. However, the **ON HOOK**, **OFF HOOK**, and **RING** switches are not functional in the SLC-M2 mode.

Disconnect the T-BERD DLC Analyzer Option

17. **PRIMARY RECEIVE and SECONDARY RECEIVE jacks**

Disconnect the cables from the DSX-1 MON jacks, then the T-BERD DLC Analyzer Option.

AUXILIARY FUNCTIONS

T-BERD MAINFRAME

T-BERD DLC ANALYZER OPTION

27. MAINFRAME — AUXILIARY FUNCTIONS

The mainframe auxiliary functions are selected using the **MODE** switch. Press the **MODE** switch once from an operating mode (e.g., T1 D4), to select the AUX mode. When the AUX mode appears, the auxiliary functions are selected by pressing the **PATTERN** switch.

Table 4 lists the auxiliary functions by mainframe and option. The auxiliary functions are described in factory-default order.

Table 4
T-BERD 209A/211 Auxiliary Functions

Auxiliary Function	Description
Mainframe	
AUX USER1	User 1 Programmable Test Pattern
AUX USER2	User 2 Programmable Test Pattern
AUX RESPONSE	Loop Code Response Function
AUX PGM LPUP	Programmable Loop-up Code
AUX PGM LPDN	Programmable Loop-down Code
AUX BAUD	RS-232 Printer/Remote Control Baud Rate
AUX PARITY	RS-232 Printer/Remote Control Parity
AUX HALT/CONT	Action on Pattern Synchronization Loss
AUX PRNT FMT	Results Printout Format
AUX TERM	RS-232 Printer/Remote Control Line Terminator
AUX PLS MASK	Pulse Shape Measurement Mask
AUX RES HIST	Results History Buffer
AUX HIST CLR	Clear History and Printer Buffers
AUX ERR SEL	BPV and Logic Error Burst Duration
AUX FRM ERR	Frame Error Insertion
AUX ER RATE	BPV and Logic Error Insertion Rate
AUX CLOCK	Set Clock Time
AUX DATE	Set Date
AUX TEST LEN	Set Timed Test Length Duration

Table 4
T-BERD 209A/211 Auxiliary Functions (Continued)

Auxiliary Function	Description
AUX GRAPH	Print Graph Function
AUX LP CODE	Loop Code Select
AUX ESF LOOP	ESF Loop Code Select
AUX MULTIPAT	MULTIPAT Pattern Selection and Duration Conrol
Battery Option (T-BERD 209A Only)	
AUX PWR SAVE	Battery Power Save Control
Jitter Spectral Analysis Option (T-BERD 211 Only)	
AUX JIT S/A	Jitter Spectral Analysis Control
AUX JIT MASK	Spectral Analysis Jitter Mask Select
AUX JIT TRIG	Spectral Analysis Jitter Trigger Select
Advanced BERT Option	
AUX LUP	Programmable Long User Pattern
Fractional T1 Option	
AUX FT1 CHAN	Fractional T1 Channel Bandwidth
AUX FT1 SETUP	FT1 Idle Code and Channel Rate
Enhanced ESF Option	
AUX PRM	Performance Report Message Control

28. T-BERD DLC ANALYZER OPTION — AUXILIARY FUNCTIONS

The T-BERD DLC Analyzer Option auxiliary functions are selected with the **AUX** switch.

Press the **FRAME** switch to scroll through the three auxiliary groups: CHANNEL, TRANSMIT, and TIME. The auxiliary group name appears in the FRAME window.

Press the **FORMAT** switch to scroll through the auxiliary functions within a selected auxiliary group. The auxiliary function name appears in the FORMAT window.

Press the **RESULTS I Results** or **RESULTS II Results** switch to select or modify the auxiliary function.

The T-BERD DLC Analyzer Option provides the following auxiliary functions listed in Table 5.

Table 5
T-BERD DLC Analyzer Option Auxiliary Functions

Auxiliary Function	Description
CHANNEL/VF DROP	T1 Channel VF Drop
CHANNEL/TRUNK TYPE	T1 Channel Trunk Type
CHANNEL/CHANNEL SCROLL	T1 Channel Scrolling
TRANSMIT/LBO	T1 Transmitter Line Build-Out
TIME/SET TIME	Set Time of Day
TIME/SET DATE	Set Date

T-BERD MAINFRAME
SIGNAL ALARMS AND TEST RESULTS

SIGNAL ALARMS

TEST RESULTS

SUMMARY CATEGORY

LOGIC CATEGORY

BPV &FRAME CATEGORY

SIGNAL CATEGORY

JITTER (T-BERD 211 ONLY) &
WANDER CATEGORY

29. MAINFRAME — SIGNAL ALARMS

Signal Loss — 150 ms without input pulses after valid frequency and level are detected.

Pattern Sync Loss — 250 errors detected in 1000 or fewer bits.

Frame Sync Loss — On T1 D4 and T1 SLC framing, 2 out of 5 F_t bits in error causes frame synchronization loss. On T1 ESF and T1 ESFz framing, 2 out of 5 frame bits in error causes frame synchronization loss.

Excess Zeros — In T1 signals, excess zeros occur in AMI coding with 16 consecutive zeros and B8ZS coding with 8 consecutive zeros. In T1C signals, excess zeros occur with 34 consecutive zeros.

Yellow Alarm — In T1 D4 and T1 SLC framing, a Yellow Alarm occurs when Bit 2 is a 0 for 255 consecutive channels. In T1 ESF framing, a Yellow Alarm occurs when 256 bits, ±16 bits, of a repetitive 1111 1111 0000 0000 ... pattern is received in the 4 kb/s datalink.

All Ones — In unframed T1 or T1C signals, 2048 consecutive ones constitutes an All Ones condition. In framed T1 signals, 256 consecutive DS0 channels with all ones constitutes an All Ones condition.

Ones Density — Less than n ones in 8(n+1) bits, where n = 1 to 23 per AT&T PUB62411 and ANSI T1.403. The LED is disabled when receiving a T1-QRSS pattern or any T1C signal.

Pulse Shape — Received pulse shape exceeds selected pulse shape mask specification.

Jitter (T-BERD 211 only) — When the Jitter Spectral Analysis Option is not installed, excess jitter is declared if wideband jitter exceeds 5 UI or highband jitter exceeds 0.1 UI . When the Jitter Spectral Analysis Option is installed but turned off, excess jitter is declared if wideband jitter exceeds 5 UI or highband jitter exceeds 0.1 UI. When the Jitter Spectral Analysis Option is installed and turned on, excess jitter is declared if the measured jitter exceeds 100% of the selected jitter mask.

Low Battery (T-BERD 209A only) — When the optional lead-acid battery is installed, the LED illuminates approximately 15 minutes before the battery is completely drained of power. The history LED illuminates when the current LED is illuminated and AC power is applied to the instrument.

30. MAINFRAME — TEST RESULTS

The categories are selected with the **RESULTS I** and **II Category** switches. Pressing the switch illuminates the category LED and displays the previously displayed category result. The category results are displayed by pressing the **RESULTS I** and **II Results** switches.

The six categories and the available results are listed as follows.

SUMMARY Category

Mainframe
00-BIT ERRORS
09-SLIPS
25-VIOLATIONS
30-FRM ERRORS
32-CRC ERRORS
34-FRM LOS CNT
40-RX FREQ, Hz
44-PULSE SHAPE
51-TIMING SLIP

Enhanced ESF Option
17-FAR FRM ES
18-FAR FRM SES
19-FAR BPV SEC
20-FAR SLP SEC
22-FAR CRC ERR

LOGIC Category

Mainframe
00-BIT ERRORS
01-ASYN ER SEC
04-BIT ERR RT
05-ER FREE SEC
06-%EFS
07-SYN ERR SEC
08-OUT SYN SEC
09-SLIPS

G.821 Performance Analysis Option
10-SEV ERR SEC
11-%SEV ER SEC
12-DEGR MIN
13-%DEGR MIN
14-UNAVL SEC
15-%AVLBILITY
16-CSES

BPV & FRAME Category

Enhanced ESF Option	Mainframe
17-FAR FRM ES	25-VIOLATIONS
18-FAR FRM SES	26-BPV SECONDS
19-FAR BPV SEC	27-BPV RATE
20-FAR SLP SEC	28-FRM ERR SEC
21-FAR PRM SEC	29-FRM SES
22-FAR CRC ERR	30-FRM ERRORS
22-FCRC 1	31-FRM ER RATE
22-FCRC 2-5	32-CRC ERRORS
22-FCRC 6-10	33-CRC ERR SEC
22-FCRC11-100	34-FRM LOS CNT
22-FCRC101-319	35-FRM LOS SEC
22-FCRC>319	36-CRC SES
23-PAY SRC	37-CRC ERR RT

SIGNAL Category

Mainframe	
40-RX FREQ, Hz	47-FALL TIME
41-RX LEVEL (dBdsx)	48-UNDERSHOOT
42-RX LEVEL (dBm)	49-OVERSHOOT
43-RX LEVEL (Vp-p)	50-SPX CURRENT
44-PULSE SHAPE	51-TIMING SLIP
45-PULSE WIDTH	53-SLP ANA SEC
46-RISE TIME	

TIME Category

Mainframe	
60-SIG LOS SEC	64-TEST END IN
61-ALARMED SEC	65-CLOCK TIME
62-TEST LENGTH	66-DATE
63-ELAPSE TIME	

WANDER Category (T-BERD 211 Only)

70-WANDER +PK
71-WANDER -PK
72-P-P WANDER
73-15m WANDER
74-24h WANDER
75-TIE WANDER

JITTER & WANDER Category (T-BERD 211 Only)

Mainframe

70-WANDER +PK
71-WANDER -PK
72-P-P WANDER
73-15m WANDER
74-24h WANDER
75-TIE WANDER
80-WB/HB JIT
81-WB JITTER
82-HB JITTER
84-MAX WB JIT
85-MAX HB JIT

Jitter Spectral Analysis Option

88-SA P/F
89-SA FREQ (auto scan)
90-SA FREQ (man. scan)

31. MAINFRAME — SUMMARY CATEGORY

The following SUMMARY category displays key non-zero, out-of-specification, or PRM test results without having to scroll through all the categories to find them.

00-BIT ERRORS

Bit Errors — A count of received bits which have a value opposite that of the corresponding transmitted bits (Mark or Space) after pattern synchronization is achieved.

09-SLIPS

Pattern Slips — A count of the total number of pattern slips since the beginning of the test.

17-FAR FRM ES

Far-End Frame Error Seconds — A count of the seconds in which one or more frame errors occurred in the received signal at the far end. This result reports on the PRM Frame-Synchronization-Bit Error Event Bit (FE = 1) status.

18-FAR FRM SES

Far-End Severely Errored Framing Seconds — A count of the seconds in which two or more frame errors occurred in less than 3 ms in the received signal at the far end. This result reports on the PRM Severely-Errored Framing Event Bit (SE = 1) status.

19-FAR BPV SEC

Far-End BPV Seconds — A count of the seconds in which one or more BPVs occurred in the received signal at the far end. This result reports on the PRM Line-Code Violation Event Bit (LV = 1) status.

20-FAR SLP SEC

Far-End Controlled Slip Seconds — A count of the seconds in which controlled slips occurred in the received signal at the far end. This result reports on the PRM Controlled-Slip Event Bit (SL = 1) status.

22-FAR CRC ERR

Far-End CRC Error Events — A count of the minimum number of CRC errors reported in the following 22-FCRC results. A ">" (greater than) preceding the count indicates that the Bins 2 through 6 are non-zero. This result reports on the PRM CRC Error Event Bits (G1 to G6) status.

25-VIOLATIONS

Bipolar Violation Count — A count of BPVs detected since the start of the test (excluding intentional violations found within B8ZS codes).

30-FRM ERRORS

Frame Errors — A count of the frame errors detected since the start of the test. For D4-compatible framing, frame errors are counted if either an Ft or an Fs frame bit is in error. For ESF framing, frame errors are counted on FPS bits. In T1 SLC mode, frame errors are counted only if an error is found on an Ft bit.

32-CRC ERRORS

CRC Errors — A count of CRC errors detected. CRC errors are counted only when ESF framing is present in the received T1 data.

34-FRM LOS CNT

Frame Loss Count — A count of discrete losses of frame synchronization that occurred during the test.

40-RX FREQ, Hz

Receive Frequency in Hz — The frequency of the clock recovered from the received data.

44-PULSE SHAPE

Pulse Shape — A PASS/FAIL result which shows whether the T1 pulse shape is within the boundary of the specified pulse mask.

51-TIMING SLIP

Controlled Timing Slips — Timing slips are counted when the RECEIVER input has slipped ±193 bit time periods from the T1 REF input. Single bit slips are displayed graphically next to timing slips.

In addition to the test results, the following status messages appear in the SUMMARY category as required.

ALL RESULTS OK — When all summary results are error-free or meet specification boundaries (e.g., RX FREQ, Hz and PULSE SHAPE), this message appears in the display.

ALL RESULTS UNAVAILABLE — Displayed at test restart when the instrument has not synchronized with the received signal.

SIGNAL LOSS — The received signal has been lost. The receiver status LEDs are not illuminated, and the Alarm status LEDs are illuminated.

FAILED PATTERN — Indicates the failed test patterns when performing a BRIDGTAP or MULTIPAT test. The failed pattern is also indicated.

B8ZS DETECTED — Indicates the presence of B8ZS coding in the received signal when the **CODE** switch is set to the AMI position.

NOT B8ZS COMPATIBLE — Indicates the received signal is not B8ZS compatible when transmitting B8ZS encoded ALL ZEROS.

32. MAINFRAME — LOGIC CATEGORY

00-BIT ERRORS

Bit Errors — A count of received bits which have a value opposite that of the corresponding transmitted bits (Mark or Space) after pattern synchronization is achieved.

01-ASYNC ERR SEC

Asynchronous Error Seconds — A count of test seconds where one or more bit errors occurred.

04-BIT ERR RT

Bit Error Rate — The ratio of bit errors to received pattern data bits.

05-ER FREE SEC

Error-Free Seconds — A count of the seconds during which pattern synchronization is maintained through the entire second and no bit error occurred.

06-% EFS

% Error-Free Seconds — The ratio, expressed as a percentage, of error-free seconds to the total number of seconds during which pattern synchronization is present.

07-SYN ERR SEC

Synchronized Error Seconds — A count of errored seconds synchronized to the occurrence of an error (the count and time interval begin with the occurrence of an error).

08-OUT SYN SEC

Out-of-Synchronization Seconds — A count of the total number of seconds, since the beginning of the test, during which pattern synchronization was not maintained for the entire second.

09-SLIPS

Pattern Slips — A count of the total number of pattern slips since the beginning of the test.

10-SEV ERR SEC

Severely Errored Seconds — A count of seconds during which the bit error ratio was worse than 10^{-3} within the available time.

11-%SEV ER SEC

% Severely Errored Seconds — The ratio, expressed as a percentage, of severely errored seconds to the number of available seconds.

12-DEGR MIN

Degraded Minutes — A count of minutes during which the bit error ratio was worse than 10^{-6}.

13-%DEGR MIN

% Degraded Minutes — The ratio, expressed as a percentage, of degraded minutes to the number of available minutes.

14-UNAVL SEC

Unavailable Seconds — A count of unavailable time.

15-%AVLBILITY

% Availability — The ratio, expressed as a percentage, of available seconds to the number of test seconds.

16-CSES

Consecutive Severely Errored Seconds — A count of the number of groups of three or more contiguous severely errored seconds in which an error rate worse than 10^{-3} was found in each second.

33. MAINFRAME — BPV & FRAME CATEGORY

17-FAR FRM ES

Far-End Frame Error Seconds — A count of the seconds in which one or more frame errors occurred in the received signal at the far end. This result reports on the PRM Frame-Synchronization-Bit Error Event Bit (FE = 1) status.

18-FAR FRM SES

Far-End Severely Errored Framing Seconds — A count of the seconds in which two or more frame errors occurred in less than 3 ms in the received signal at the far end. This result reports on the PRM Severely-Errored Framing Event Bit (SE = 1) status.

19-FAR BPV SEC

Far-End BPV Seconds — A count of the seconds in which one or more BPVs occurred in the received signal at the far end. This result reports on the PRM Line-Code Violation Event Bit (LV = 1) status.

20-FAR SLP SEC

Far-End Controlled Slip Seconds — A count of the seconds in which controlled slips occurred in the received signal at the far end. This result reports on the PRM Controlled-Slip Event Bit (SL = 1) status.

21-FAR PRM SEC

Far-End Performance Report Seconds — A count of the total number of seconds, since test restart, in which a valid PRM was received.

22-FAR CRC ERR

Far-End CRC Error Events — A count of the minimum number of CRC errors reported in the following 22-FCRC results. A ">" (greater than) preceding the count indicates that the Bins 2 through 6 are non-zero. This result reports on the PRM CRC Error Event Bits (G1 to G6) status. When the result is displayed and the indicated count is an approximation of the actual CRC error count, a ">" (greater than) sign precedes the result count.

22-FCRC 1

Far-End CRC 1 Bin — A count of the seconds with only one CRC error reported in the received signal at the far end. This result reports on the first PRM CRC Error Event Bit (G1 = 1).

22-FCRC 2-5

Far-End CRC 2 to 5 Bin — A count of the seconds with 2 to 5 CRC errors reported in the received signal at the far end. This result reports on the second PRM CRC Error Event Bit (G2 = 1).

22-FCRC 6-10

Far-End CRC 6 to 10 Bin — A count of the seconds with 6 to 10 CRC errors reported in the received signal at the far end. This result reports on the third PRM CRC Error Event Bit (G3 = 1).

22-FCRC11-100

Far-End CRC 11 to 100 Bin — A count of the seconds with 10 to 100 CRC errors reported in the received signal at the far end. This result reports on the fourth PRM CRC Error Event Bit (G4 = 1).

22-FCRC101-319

Far-End CRC 101 to 319 Bin — A count of the seconds with 101 to 319 CRC errors reported in the received signal at the far end. This result reports on the fifth PRM CRC Error Event Bit (G5 = 1).

22-FCRC>319

Far-End CRC 320 to 333 Bin — A count of the seconds with 320 to 333 CRC errors reported in the received signal at the far end. This result reports on the sixth PRM CRC Error Event Bit (G6 = 1).

23-PAY SRC

Far-End Payload Source/Loopback — Identifies the direction of the PRM according to the PRM Command/Response Bit (C/R) and the Payload Loopback Activated Bit (LB). In end-to-end applications, a customer generated PRM is indicated as CUST (C/R = 0 and LB = 0) and a carrier generated PRM is indicated as CARR (C/R = 1 and LB = 0) in the display. In payload loopback

applications, the customer generated PRM is indicated as CUST LOOP (C/R = 0 and LB = 1) when the customer is looped back and the carrier generated PRM is indicated as CARR LOOP (C/R = 1 and LB = 1) when the carrier is looped back.

25-VIOLATIONS

Bipolar Violation Count — A count of BPVs detected since the start of the test (excluding intentional violations found within B8ZS codes).

26-BPV SECONDS

BPV Seconds — A count of the seconds within which one or more BPVs occurred.

27-BPV RATE

BPV Rate — The ratio of BPVs to the number of data bits received.

28-FRM ERR SEC

Frame Errored Seconds — A count of the seconds during which one or more frame errors occurred.

29-FRM SES

Severely Errored Frame Seconds — A count of the seconds during which the total number of frame errors equalled 12 or more (D4 framing only).

30-FRM ERRORS

Frame Errors — A count of the frame errors detected since the start of the test. For D4-compatible framing, frame errors are counted if either an Ft or an Fs frame bit is in error. For ESF framing, frame errors are counted on FPS bits. In T1 SLC mode, frame errors are counted only if an error is found on an Ft bit.

31-FRM ER RATE

Frame Error Rate — The ratio of frame errors to the number of analyzed framing bits.

32-CRC ERRORS

CRC Errors — A count of CRC errors detected. CRC errors are counted only when ESF framing is present in the received T1 data.

33-CRC ERR SEC

CRC Errored Seconds — A count of seconds within which one or more CRC errors are detected.

34-FRM LOS CNT

Frame Loss Count — A count of discrete losses of frame synchronization that occurred during the test.

35-FRM LOS SEC

Frame Loss Seconds — A count of seconds since initial frame synchronization during which one or more frame synchronization losses occurred or during which frame synchronization could not be achieved.

36-CRC SES

Severely Errored CRC Seconds — A count of seconds during which the total number of CRC errors and frame synchronization losses equalled 320 or more.

37-CRC ERR RT

CRC Error Rate — A count of CRC errors divided by the total number of ESF superframes analyzed.

34. MAINFRAME — SIGNAL CATEGORY

40-RX FREQ, Hz

Receive Frequency in Hz — The frequency of the clock recovered from the received data.

41-RX LEVEL dBdsx

Receive Level in dBdsx — The level of the received signal in dB relative to a standard 3-volt base-to-peak signal (DSX level).

42-RX LEVEL dBm

Receive Level in dBm — The power level of an all-ones signal (applicable only when all ones is detected).

43-RX LEVEL V p-p

Receive Level in Volts — The level of the received signal in peak-to-peak volts. The signal level is displayed as V or mV when it is higher or lower than 1 volt, respectively.

44-PULSE SHAPE

Pulse Shape — A PASS/FAIL result which shows whether the T1 pulse shape is within the boundary of the specified pulse mask.

45-PULSE WIDTH

Pulse Width — The pulse width of a T1 pulse, displayed in nanoseconds. This measurement is not available in T1C mode.

46-RISE TIME

Pulse Rise Time — The time interval between the 10% and 90% points of the rising edge of the T1 pulse, displayed in nanoseconds. This measurement is not available in T1C mode.

47-FALL TIME

Pulse Fall Time — The time interval between the 10% and 90% points of the falling edge of the T1 pulse, displayed in nanoseconds. This measurement is not available in T1C mode.

48-UNDERSHOOT

Undershoot — The level difference from the minimum point to the 0% point of the T1 pulse. UNDERSHOOT is displayed as a percent of the normalized pulse where the normalized pulse height equals 100%.

49-OVERSHOOT

Overshoot — The level difference from the maximum point to the 100% point of the T1 pulse. OVERSHOOT is displayed as a percent of the normalized pulse where the normalized pulse height equals 100%.

50-SPX CURRENT

Simplex Current — The magnitude of the simplex current flowing between the transmit output tip and ring and the receive input tip and ring.

51-TIMING SLIP

Controlled Timing Slips — Timing slips are counted when the RECEIVER input has slipped ±193 bit time periods from the T1 REF input. Single bit slips are displayed graphically next to timing slips (see functional description).

53-SLP ANA SEC

Timing Slip Analysis Seconds — A count of test seconds during which Timing Slip Analysis has been performed.

35. MAINFRAME — TIME CATEGORY

60-SIG LOS SEC

Signal Loss Seconds — A count of test seconds during which the signal was not present or during which one or more signal losses occurred.

61-ALARMED SEC

Alarmed Second — A count of test seconds during which a Yellow, All Ones, Excess Zeros, or Ones Density alarm was detected.

62-TEST LENGTH

Length of a Timed Test — The currently set test length for a timed test, in HHH:MM format.

63-ELAPSE TIME

Elapsed Time — The number of hours, minutes, and seconds (1) since a proper frequency and level has been detected or (2) since the last major switch change.

64-TEST END IN

Time Remaining in Timed Test — Time remaining in a timed test, in HHH:MM:SS format.

65-CLOCK TIME

Clock Time of Day — The time of day in HH:MM:SS format.

66-DATE

Date — The date in DD MMM format.

36. MAINFRAME — JITTER (T-BERD 211 ONLY) & WANDER CATEGORY

70-WANDER +PK

Maximum Positive Peak Wander — The maximum positive peak wander deviation since the beginning of the test, defined in Unit Intervals (UIs).

71-WANDER -PK

Maximum Negative Peak Wander — The maximum negative peak wander deviation since the beginning of the test, defined in UIs.

72-P-P WANDER

Peak-to-Peak Wander — The total deviation of positive-to-negative peak wander since the beginning of the test, defined in UIs.

73-15m WANDER

Maximum Peak-to-Peak Wander Over 15 Minutes — The maximum peak-to-peak wander deviation over the last 15 minutes of the test. This result is unavailable for the first 15 minutes of the test and is updated once per minute thereafter.

74-24h WANDER

Maximum Peak-to-Peak Wander Over 24 Hours — The maximum peak-to-peak wander deviation over the last 24 hours of the test. This result is unavailable for the first 24 hours of the test and is updated once per hour thereafter.

75-TIE WANDER

Time Interval Error Wander — The variation in time delay of a given timing signal with respect to the T1 reference signal or external clock source over the test interval. Valid range is +99999 UI.

The following wideband and highband jitter, and spectral jitter versus jitter mask analysis are only applicable to the T-BERD 211 JITTER & WANDER category.

80-WB/HB JIT

Wideband and Highband Jitter — A pass/fail measurement of wideband and highband jitter on a received T1 signal when compared to the CCITT O.171 jitter mask. (Pass/Fail criteria: wideband jitter greater than 5 UI; highband jitter greater than 0.1 UI.)

81-WB JITTER

Peak-to-Peak Wideband Jitter — The current amount of peak-to-peak wideband jitter, defined in UIs, updated once per second.

82-HB JITTER

Peak-to-Peak Highband Jitter — The current amount of peak-to-peak highband jitter, defined in UIs, updated once per second.

84-MAX WB JIT

Maximum Peak-to-Peak Wideband Jitter — The maximum amount of peak-to-peak wideband jitter since the last test restart, defined in UIs.

85-MAX HB JIT

Maximum Peak-to-Peak Highband Jitter — The maximum amount of peak-to-peak highband jitter since the last test restart, defined in UIs.

88-SA P/F

Spectral Analysis Content — A pass/fail comparison between the spectral content of each frequency band and the jitter mask selected in the AUX JIT MASK function.

89-SA FREQ

Relative Jitter in All 40 Frequency Bands — The relative amount of jitter present in all 40 frequency bands. Each frequency band and result are automatically scrolled in the display.

90-SA FREQ

Relative Jitter in Each Frequency Band — The relative amount of jitter present in each of the 40 frequency bands. Each frequency band is displayed manually by pressing the **RESULTS I** or **II Results** switch.

T-BERD DLC ANALYZER OPTION
SIGNAL ALARMS AND TEST RESULTS

SIGNAL ALARMS

TEST RESULTS

SUMMARY CATEGORY

DATALINK CATEGORY

CHANNEL CATEGORY

TIME CATEGORY

37. DLC ANALYZER OPTION — SIGNAL ALARMS

T1 Pulses — The green LED illuminates when valid T1 pulses are detected. The red history LED illuminates when T1 pulses are no longer detected after initial signal detection.

Frame Sync — The green LED illuminates when the T-BERD DLC Analyzer Option has achieved frame synchronization with the selected framing pattern (see **FRAME** switch). The red history LED illuminates when frame synchronization is lost, after achieving initial frame synchronization.

Alarms — The current red LED illuminates when any of the following conditions is detected in the DLC datalink.

- Major alarms
- Minor alarms
- Power/miscellaneous alarms
- Shelf alarms
- Far-end loop event
- Switch to protection line event
- Maintenance test event

If the current LED is illuminated, check the SUMMARY and DATALINK categories for the current alarms and messages. If the history LED is illuminated, check the DATALINK category for the previously received alarms and messages.

B8ZS — The current green status LED illuminates when B8ZS clear channel encoding is detected in the received signal.

38. DLC ANALYZER OPTION — TEST RESULTS

The categories are selected with the **RESULTS I** and **II Category** switches. Pressing the switch illuminates the category LED and displays the previously displayed category result. The category results are displayed by pressing the **RESULTS I** and **II Results** switches.

Most messages and results are preceded with either a "P" or "S" to indicate the input source, PRIMARY RECEIVE or SECONDARY RECEIVE.

The four categories and the available messages and results are listed as follows:

SUMMARY Category

Flashing Messages
P/S SIGNAL LOSS
P/S DATALINK SYNC LOSS
SW PROT FAILED
OPTION NOT INSTALLED

Maintenance Messages
P/S MAINT PROCEED
P/S MAINT HOOK/SEIZE
P/S MAINT TEST ALARM

Current Alarm Messages
P/S MAJOR SHELF x
P/S MAJOR NO SHELF
P/S ALARM SHELF x
P/S SHELF x ON PROT
P/S FE LOOP PROTECT
P/S FE LOOP SHELF x
P/S MINOR
P/S PWR/MISC

T1 Signal Errors
P/S VIOLATION
P/S FRM ERROR
P/S CRC ERROR

Results Messages
ALL RESULTS OK
ALL RESULTS UNAVAILABLE

DATALINK Category

Alarm Messages
P/S MAJOR SHELF x
P/S MAJOR NO SHELF
P/S ALARM SHELF x
P/S SHELF x ON PROT
P/S FE LOOP PROTECT
P/S FE LOOP SHELF x
P/S MINOR
P/S PWR/MISC

Maintenance Messages
P/S MAINT PROCEED
P/S MAINT HOOK/SEIZE
P/S MAINT TEST ALARM

Datalink Results
P/S SLC A SEC
P/S DATALINK BITS
P/S ALM FIELD

CHANNEL Category

Channel Signaling
P/S TRAFFIC CHANNEL AB
P/S TRAFFIC CHANNEL ABCD
P/S TRAFFIC TIMESLOT AB

VF Results
P/S VF LEVEL
P/S VF FREQ
P/S DATA BITS
DTMF SEQ
P/S TS CHAN

TIME Category

TIME
DATE
P/S SIG L SEC

39. DLC ANALYZER OPTION — SUMMARY CATEGORY

Flashing Messages

P/S SIGNAL LOSS

Signal Loss — This message indicates the T1 signal has been lost after initial signal presence on the indicated receiver. The message flashes until the signal returns (T1 Pulses LED illuminated).

P/S DATALINK SYNC LOSS

Datalink Synchronization Loss — This message indicates that datalink synchronization has been lost after initial datalink synchronization. The message flashes until datalink synchronization is regained.

SW PROT FAILED

Switch to Protection Line Failed — This message indicates a switch to protect request cannot be completed. The message flashes once with each occurrence.

OPTION NOT INSTALLED

Option Not Installed — An option is not currently installed or available. The message flashes once with each attempt.

Alarm Messages

P/S MAJOR SHELF x

Major Alarm on Shelf x — This message indicates a system state that is characterized by a loss of service to the subscribers served by a shelf or shelf group (x = A, B, C, or D).

P/S MAJOR NO SHELF

Major Alarm, No Shelf — This message indicates a system state that is characterized by a loss of service to the subscribers with no associated shelf alarm.

P/S ALARM SHELF x

Shelf Alarm on Shelf x — This message indicates a system state that is characterized by a loss of service to the subscribers served by the indicated shelf (x = A, B, C, or D).

P/S SHELF x ON PROT

Shelf x on Protection Line — This message indicates that one of the shelves has switched to the protection line (x = A, B, C, or D).

P/S FE LOOP SHELF x

Far-End Loop on Shelf x — This message indicates that a request is being sent to the far end to loop one of the four shelves (x = A, B, C, or D).

P/S FE LOOP PROTECT

Far-End Loop on Protection Line — This message indicates that a request is being sent to the far end to loop the protection line.

P/S MINOR

Minor Alarm — This message indicates a system state that is characterized by a non-service affecting fault.

P/S PWR/MISC

Power/Miscellaneous Alarm — This message indicates a power loss, high temperature, smoke, high water, open door, or other defined condition exists.

Maintenance Test Messages

P/S MAINT HOOK/SEIZE

On-Hook/Seize Maintenance Message — This message appears when either the on-hook or seize message is received.

P/S MAINT PROCEED

Proceed Maintenance Message — The maintenance bypass procedure continues or has succeeded.

P/S MAINT TEST ALARM

Test Alarm Maintenance Message — The maintenance bypass procedure has failed.

T1 Signal Errors

P/S VIOLATION

Bipolar Violation Count — A count of BPVs detected since the start of the test (excluding intentional violations found within B8ZS encoding).

P/S CRC ERROR

CRC Errors — A count of CRC errors detected. CRC errors are counted only when ESF framing is present in the received T1 data.

P/S FRM ERROR

Frame Errors — A count of the frame errors detected since the start of the test. For D4 or D1D framing, frame errors are counted if either an F_t or an F_S frame bit is in error. For ESF framing, frame errors are counted on FPS bits. For SLC-M1 or SLC-M2 framing, frame errors are counted only if an error is found on an F_t bit.

40. DLC ANALYZER OPTION — DATALINK CATEGORY

Alarm Messages

P/S MAJOR SHELF x

Major Alarm on Shelf x — This message indicates a system state that is characterized by a loss of service to the subscribers served by a shelf or shelf group (x = A, B, C, or D).

P/S MAJOR NO SHELF

Major Alarm, No Shelf — This message indicates a system state that is characterized by a loss of service to the subscribers with no associated shelf alarm.

P/S ALARM SHELF x

Shelf Alarm on Shelf x — This message indicates a system state that is characterized by a loss of service to the subscribers served by the indicated shelf (x = A, B, C, or D).

P/S SHELF x ON PROT

Shelf x on Protection Line — This message indicates one of the shelves has switched to the protection line (x = A, B, C, or D).

P/S FE LOOP SHELF x

Far-End Loop on Shelf x — This message indicates that a request is being sent to the far end to loop one of the four shelves (x = A, B, C, or D).

P/S FE LOOP PROTECT

Far-End Loop on Protection Line — This message indicates that a request is being sent to the far end to loop the protection line.

P/S MINOR

Minor Alarm — This message indicates a system state that is characterized by a non-service affecting fault.

P/S PWR MISC

Power Miscellaneous Alarm — This message indicates a power loss, high temperature, smoke, high water, open door, or other defined condition exists.

Maintenance Test Messages

P/S MAINT HOOK/SEIZE

On-Hook/Seize Maintenance Message — This message appears when either the on-hook or seize message is received.

P/S MAINT PROCEED

Proceed Maintenance Message — The maintenance bypass procedure continues or has succeeded.

P/S MAINT TEST ALARM

Test Alarm Maintenance Message — The maintenance bypass procedure has failed.

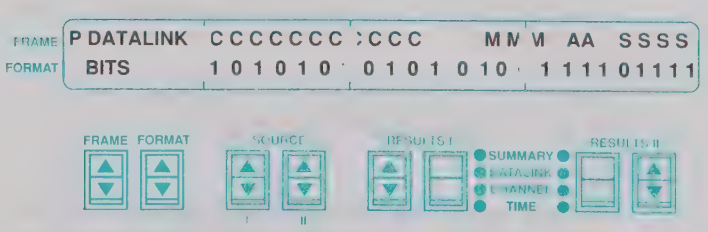
Datalink Status Results

P/S SLC A SEC

SLC Alarmed Seconds — The number of test seconds during which datalink alarms, maintenance tests, or switch to protection line messages were detected.

P/S DATALINK BITS

SLC Datalink Bits — This result displays the individual datalink bits. The display indicates the concentrator (CCCCCCCCCCC), maintenance (MMM), alarm (AA), and protection line switch (SSSS) fields. This result is only available when the T-BERD DLC Analyzer Option is frame synchronized in the SLC-M1 or SLC-M2 mode. The spoiler bits are shown without characters above them.


FRAME FORMAT
P DATALINK BITS
C C C C C C C C C C C
M M M AA SSSS
1 0 1 0 1 0 0 1 0 1 0 1 0 1 0 1 1 1 1 0 1 1 1 1
FRAME FORMAT
SOURCE
RESULTS I
RESULTS II
SUMMARY
DATALINK
CHANNEL
TIME

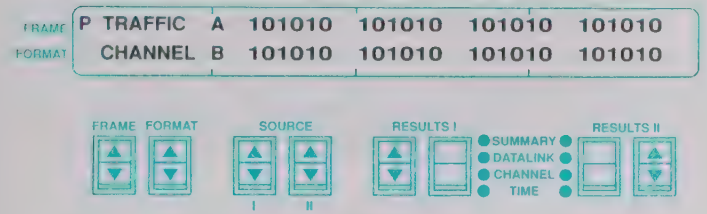
P/S ALM FIELD

Alarm Field Format — Identifies the received datalink alarm field format as either 13 bit or 16 bit.

41. DLC ANALYZER OPTION — CHANNEL CATEGORY

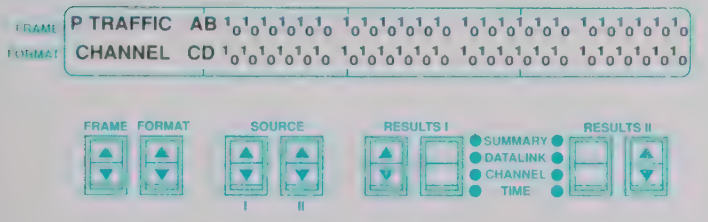
P/S TRAFFIC CHANNEL AB

AB Traffic Channel Signaling Bits — This result displays the A and B signaling bits in all 24 channels. This result is available in the SLC-M1, T1 D1D, T1 D4, and AUTO (except ESF) frame modes, but not in the SLC-M2 or T1 ESF mode.



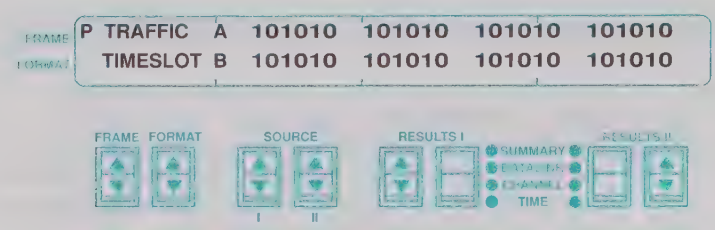
P/S TRAFFIC CHANNEL ABCD

ABCD Traffic Channel Signaling Bits — This result displays the A, B, C, and D signaling bits in all 24 channels. This result is only available in the T1 ESF frame mode.



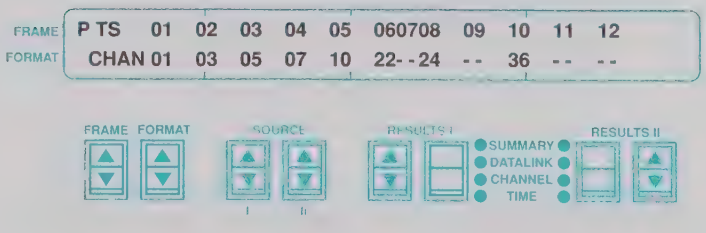
P/S TRAFFIC TIMESLOT AB

Traffic Signaling Bits for SLC-M2 Timeslots — This result displays the A and B signaling bits in all timeslots from a single receiver input. This is only available in the SLC-M2 frame mode.



P/S TS CHAN

SLC-M2 Timeslot Channel Assignments — This result displays the timeslot channel assignments of a Mode 2 SLC-96 circuit. An unassigned timeslot is indicated by two dashes (— —). This result is only available in the SLC-M2 frame mode. The result is only valid when the timeslot information is received from the central office.



P/S VF LEVEL

Received VF Signal Level in dBm — A measurement of signal power in the currently selected DS0 channel.

P/S VF FREQ

Received VF Frequency — The VF frequency, measured in Hertz, of the received VF data in the currently selected DS0 channel.

P/S DATA BITS

DS0 Channel Data Bits — Displays the binary values of the selected DS0 channel.

DTMF SEQ

Dual-Tone Multi-Frequency Sequence — Displays 11 digits of the received telephone number in the currently selected DS0 channel.

42. DLC ANALYZER OPTION — TIME CATEGORY

TIME

Time of Day — The current time of day in HH:MM:SS format. This is set with the SET TIME auxiliary function.

DATE

Date — The current date in MMM DD format. This is set with the SET DATE auxiliary function.

P/S SIG L SEC

Signal Loss Seconds — A count of test seconds during which the signal was not present or during which one or more signal losses occurred after the initial signal detection.

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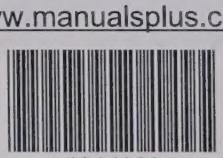

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